American Gas Association MONTHLY

Natural Gas Supply Problems

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Help Yourself Customer Plan

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Drying Foods on Gas Ranges

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Gas Summer Air Conditioning

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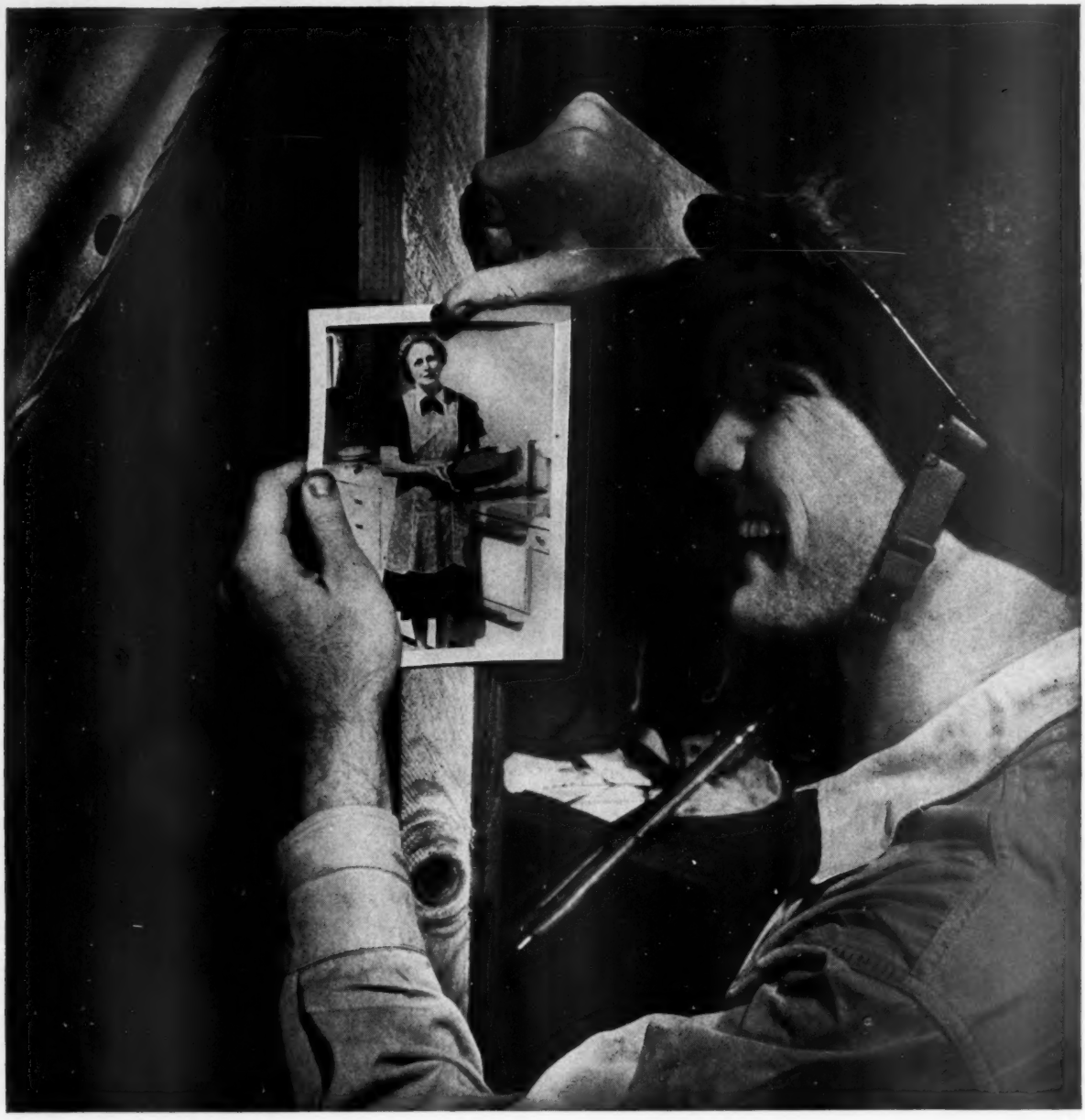
Anaerobic Corrosion Research

May 1943

VOLUME XXV NUMBER 5



"You're my pin-up girl, Mom!"

"Let the other fellows decorate the tent with glamour gals – I'm pinning up that swell snap Dad took of you at the Gas Range. Because I know darn well that you're in there pitching – doing everything you can to help get this war over with and *me* home sooner. I think it's great you and Dad have a victory garden – (and say, all that canning you're going to do sure sounds good – be sure to save a jar of peaches for me!) And I see by your letter you've learned to do that new 'waterless' kind of cooking that saves vitamins – And that you're doing your best to save Gas at home – say, that's the stuff – because, maybe you don't know it, but that Gas is mighty important in making tanks and guns – So hurray for you – Mom – it makes me proud as punch to know you're doing such a swell job back home. And I say God Bless you every time I look at *my* pin-up girl."

LET YOUR GAS COMPANY HELP. Today, every one of the 85,000,000 Americans who rely on Gas for cooking can work for victory by saving food, vitamins and Gas. Let your Gas Company tell you the best ways to do it – and how to cook and process food for war-time meals.

AMERICAN GAS ASSOCIATION

Buy War Bonds today – save for the Certified Performance Gas Range of Tomorrow

GAS ***is vital to war production . . . use it wisely!***

American Gas Association MONTHLY

CONTENTS FOR MAY 1943

Gas industry conferences blossomed like Spring flowers last month when Accounting, Natural Gas, and Distribution meetings were held in Cincinnati. While these meetings were held after the MONTHLY *deadline, important papers were received in time for publication. . . . Two notable contributions are worthy of careful reading and re-reading, as they are masterly summaries of war and post-war natural gas industry prospects. Chairman Bay gives an able report on current problems of meeting tremendous demands for gas, while K. S. Adams looks beyond the turmoil in a provocative analysis of natural gas derivatives which rival Aladdin's lamp in spectacular possibilities. . . . From the Distribution Conference comes Mr. Bittinger's description of Washington's "help yourself" program which has aided substantially in coping with war-created shortages. . . . H. P. Morehouse presents a case history of a gas summer air conditioning installation which is complete in every detail and fraught with significance. As he says, recent developments give gas a trump card for its post-war hand. . . . A scientific study of great practical value in warding off the ravages of pipe line corrosion is reported by R. L. Starkey and K. M. Wight.*

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Keeping "Natural" Rolling—A vital link in the wartime fuel supply line is graphically portrayed in this picture of "Slim" Jordan loading a tank car at the United Gas Pipe Line Company's Myrtis gasoline plant. Photographed by William J. Viers, two-time winner in MONTHLY frontispiece contest.

American Gas Association MONTHLY

JAMES M. BEALL, *Editor*

NATURAL GAS
...Industry Supply Problems Under War Conditions

By BURT R. BAY*
Chairman, Natural Gas Section
American Gas Association

IT is a plain statement of fact to say that world conditions of today overshadow those of a like nature that have gone before. They dominate our thoughts and acts; they influence our lives and habits; they are the motivating control over commerce and industry, and upon their outcome hinges our very destiny. Thus the war becomes the source of our problems and the winning of the war, the first order of business for all of us.

The history of this nation is replete with proof that the American people have risen to greater heights each time of emergency. Today, less than seventeen months after Pearl Harbor, there is evidence on every hand that history is repeating itself. In this short space of time an awakened America has constructed a gigantic war machine—a machine that is now producing the implements of war at a rate that baffles the imagination. Typical of this aroused spirit of a democratic people, the productive enterprise of American industry continues to show gains in output, month after month, and the mobilization of our fighting forces goes forward in keeping with the progressively increased output of ships, tanks, planes, guns and ammunition. The profound influences of total war serve only to supply greater incentive to all people and all industry of this nation.

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Supporting this vast program, and just as essential to its success as men and munitions, are all of the services of supply of this country—services that constitute an industrial empire and extend to all phases of the production of foodstuffs and wearing apparel—all forms of transportation—the production and distribution of coal, oil, power, gas, and many other kinds of business enterprise.

These service industries have a double responsibility in times of war, which in effect means that all of the new demands for products and services arising from war are superimposed upon the normal requirements of each such industry. The resultant abnormalities call for the fullest and most effective use of existing facilities and in instances added capacity in the form of new facilities.

Complicating the whole effort to carry these double burdens are the existing shortages of critical materials and the loss of workers to the armed services and to war industries. The resulting conditions, already sufficiently grave to cause widespread concern, will lead to shortages of supply and a partial breakdown of our transportation systems, if the present trend continues too long. These two factors provide today's basic problems of most industries of the type referred to, although there are many others of a lesser nature that take much of the time of business management and thus serve to divert attention from the nation's No. 1 job.

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I was once associated with a man who said that there are really only two things, fundamental to the conduct of the natural gas business—"get the gas and get it to market." That is an abstract way of describing an operation which involves many elements of risk, and requires somewhat the same degree of engineering, operating, and sales experience and skill that attaches to the highly complicated business of the oil industry, yet these two principles seem to stand out as the origin of the really important problems presently confronting our industry. I will grant that there are many others of a different nature—Some that cause confusion and others that create an atmosphere of uncertainty. Yet, if we but stop to think of the tasks that have made up our daily routine in recent months and the manner of handling each situation as it has presented itself, we will recall

Presented at Natural Gas Management Conference, Cincinnati, Ohio, April 28, 1943.
* President, Northern Natural Gas Company, Omaha, Nebraska.

Natural Gas Management Conference

Burt R. Bay

AS this issue of the MONTHLY went on the press, the Natural Gas Management Conference, sponsored by the American Gas Association, was being held April 28 in Cincinnati, Ohio. Under the chairmanship of Burt R. Bay, president, Northern Natural Gas Co., Omaha, Nebraska, government and industry officials reviewed the natural gas industry's problems and responsibilities.

Chairman Bay's outstanding contribution is reproduced herewith. Another valuable paper on the "Future of Natural Gas and Its Derivatives," by K. S. Adams, president, Phillips Petroleum Co., Bartlesville, Okla., appears elsewhere in this issue. Other features of the conference will be covered in the June issue.

that there was a solution for many of the problems of yesterday and, while those of the future may be more perplexing, the answers will only be found by facing the future with courage and determination. It is conceivable that many of them which even now seem to plague our existence or impede our progress will prove to be little more serious than the grain of sand that gets in our shoe and serves as an irritant as we plod life's highway in these troublesome days.

War Challenge Accepted

In times such as we are living through, the abundance of supply of all vital materials becomes a matter of greatest importance because our very lives and all of our hopes for the future depend upon our ability to keep on hand at points of consumption all of the sinews of war in the form of the raw materials needed to keep our industrial processes operating at capacity. The accomplishment of this objective compels self-sufficiency to the highest degree attainable and it is only natural that this purpose has resulted in a great amount of study being given to all of the products and processes that have a part in our radically changed economic life. This has been especially true of the natural resources, which can be made available within our own boundaries, as many of them are vital war materials. Since natural gas is definitely one of those materials, the presently available supplies and future recoverable reserves of natural gas in the country have been subjected to this careful study and scrutiny.

Fortunately for those of us living in the United States, a Benevolent Creator endowed our country with a large supply of natural gas. This has been harnessed and put to work, and of great importance in this hour of need is the fact that it has been made available for use in most of the centers of industry throughout the country. Equally important is the fact that it now supplies some of the essential domestic needs of about one-third of the nation's population.

In other forms, natural gas or some of its constituents finds its way into the manufacture of motor fuel, it becomes a component of aviation gasoline where it serves in all of the theatres of war—it adds strength and resistance to wear to the tires used on jeeps, trucks, and flying Fortresses—it becomes a principal element of synthetic rubber—it serves to inflate the blimps that patrol our coast lines, and it takes form and is used otherwise as solvents, plastics, and explosives. What more need be said of the worth of this product in times of war—a product that for sheer versatility of uses is the marvel of the age—a product of an industry that is still youthful and retains its virility, yet one that is sufficiently old in experience to have attained the respectability of tradition.

Long before the day of December 7, 1941, when war was forced upon the American people, the natural gas industry was keenly aware of the many new burdens and responsibilities that even then seemed inevitable. It was also aware of the facts that with the advent of war, these would be added to the normal requirements of the peacetime pursuits of the industry and the need for our product would continue to grow with the passing of time in somewhat direct relationship with the increased tempo of war manufacturing. The men of the industry accepted this challenge and the results are clearly written in the record of the industry's performance to date which discloses that all previous totals of production and consumption have been exceeded by substantial margins. This has been accomplished partly by the preparations made in advance of the outbreak of war and more recently, with the advent of all of the restrictions upon the use of critical materials, by operating our plant at a higher rate of efficiency.

The sheer will to accomplish more to help the war effort cannot maintain this upward curve of performance indefinitely and sooner or later, unless the problems of the industry are recognized by the governmental agencies in control of the supply and distribution of materials, we shall cease to register gains and may slip backwards. After all, the maintenance of our stock in trade, natural resource that it is, requires a never-ending expenditure of labor and materials in the drilling of wells and the lifting and laying of pipe lines as old fields give out and new ones are developed. We cannot suspend this type of operation year after year and continue to contribute to the war effort on the present scale, neither can we make a greater contribution unless there is recognition of all of the needs such an obligation entails.

Possibly more expressive of these points are some of the data contained in recent reports pertaining to the natural gas industry. Net additions to "Utility Plant" of the entire industry for the year of 1941, which includes investments in gas pipe line and distribution properties, involved the expenditure of about one hundred and twenty million dollars. While complete data for 1942 are not yet available, it seems certain that like expenditures will only be a fraction of the 1941 total.

Singling out the item of gas well completions, the record discloses that there were two thousand nine hundred and eleven wells drilled in the year of 1941 and the average of such comple-

tions for the five years ended with 1941 was two thousand five hundred and one. For the year of 1942, the number of gas wells drilled was only two thousand and eighty-nine which was eight hundred and twenty-two less than the total for 1941.

The conclusions I draw from this brief and admittedly incomplete showing of the situation presently confronting the industry are that within reasonable limits, the capacity of pipe line systems to transmit gas is frozen until greater amounts of steel are made available and with regard to supply, the margin of difference between the total deliverability of all producing gas wells and the capacity of existing transmission facilities is a gradually reducing quantity. In some producing areas, this latter condition is not yet a matter of moment but in others it is one that compels consideration now.

Appalachian Area

Any analysis of our gas supply problems by areas poses some odd and radically different situations. By way of illustration, there are some fifty-four thousand producing gas wells in the entire country, exclusive of combination wells producing both oil and gas, and of this total number of gas wells, forty-two thousand are located in the five states of New York, Pennsylvania, Ohio, West Virginia, and Kentucky, which comprise the Appalachian gas area. The annual volume of natural gas currently produced and marketed in such area exceeds four hundred billion cubic feet, which approximates fifteen per cent of the total of all marketed natural gas. To maintain this rate of production, during recent years, fifty-three to seventy per cent of the total of all new gas wells completed have been drilled within these five states.

The natural gas produced in the Appalachian area, aside from supplying the domestic and commercial needs of some three million domestic and commercial consumers, has long been the prime fuel for countless specialized manufacturing processes throughout this highly industrialized area. Therefore, the continued maintenance of a supply equal to the total requirement imposed by all consumers becomes a matter that can neither be cast aside nor treated lightly. The answer to the immediate situation in this area probably lies in increased drilling—the long range view points toward the need for the importation of gas from other producing areas.

Rocky Mountain States

In those middle western and Rocky Mountain states which afford substantially all of the market outlet in the area lying north of New Mexico, Texas, Arkansas and Kentucky, the current annual rate of consumption of natural gas for all purposes closely approximates one-fourth of the total of all marketed natural gas in the country. Of this total of some seven hundred and fifty billion cubic feet, about forty per cent originates in the Hugoton and Texas Panhandle fields where, generally speaking, the reserves are ample and the maximum rate of withdrawal by pipe lines is not excessive. There are however local situations and conditions applicable to each of these producing fields that merit and will require consideration with the passing of time.

The remaining sixty per cent of the supply of these states has its origin in some two hundred and fifty different gas fields or producing areas. A few of these sources of natural gas might be classified as flush, others have declined considerably and some will soon reach the point of abandonment. Quite a lot of concern already exists in the minds of the executives of those companies whose properties are dependent to any considerable extent upon the latter named sources of supply. The remedy lies in making available to such companies, enough steel to drill needed wells and to extend facilities to other sources of supply as the total gas reserves of the area are entirely adequate if gas from the more prolific sources can be made available to sections and communities where there is evidence of an impending shortage.

Orchids from Mr. Krug

J. A. KRUG, director of the Office of War Utilities, War Production Board, in the following letter addressed to the American Gas Association April 20, strongly endorsed the gas industry's recent conservation program:

> "The intensive advertising campaign to promote conservation carried on by your Association and the gas industry during the past winter has been a splendid job.
>
> "I am certain that a large measure of the success of many companies in meeting unprecedented demands for gas service is attributable to that campaign. In many cases, the emergency appeals by radio and in the press for voluntary domestic curtailment during the extreme cold weather assisted materially in assuring gas service for vital war plants and averted serious interruption of service for essential civilian requirements.
>
> "An especially patriotic contribution was made by the manufactured gas companies in the critical fuel oil shortage areas by their appeals to consumers to reduce gas consumption to save fuel. This action was taken notwithstanding the fact that many of the companies concerned had more than adequate capacity to meet all demands.
>
> "Your Association and the gas industry can well be proud of last winter's record, and I am confident we can depend upon your continued cooperation to meet the war production goals ahead—goals which we all know will tax our resources to the utmost."

Southwestern Gas Reserves

Some of the most prolific of the known sources of natural gas are in the states of Texas and Louisiana and with large reserves available in these states and lesser reserves in adjoining states, market outlets of tremendous proportions have been developed throughout the south. Stated in another way, five southern states, New Mexico, Texas, Arkansas, Louisiana, and Mississippi, produce approximately one-half of all of the natural gas marketed in this country and they consume within their own borders almost eighty per cent of the gas they produce. Oddly enough, these states produce this volume of gas, except as it is supplemented with casinghead residue gas, from about ten per cent of the total number of all gas wells, which attests to the nature of the available supply.

Another major influence, favorably affecting both the present and future gas supply of the area, is the growth and development, during recent years of recycling and condensate recovery operations. With due regard to these favorable factors, the very magnitude of the natural gas operations carried on in these states, the constantly growing fuel needs of an expanding southern industry, and the diverse nature of the different sources of gas supply all contribute to the problems of the industry in this area and add to their complexity in war times.

West Coast Supply

On the west coast, substantially all of the natural gas is produced and consumed in the State of California. Here the producing situation is somewhat unlike that existing in any other section of the country. The current annual rate of production and sales of natural gas in the state, as in the Appalachian area, approximates 400 billion cubic feet. Ordinarily less than ten per cent of this volume is produced as dry gas from gas wells and more than ninety per cent of the total is produced in conjunction with oil. Since the preponderance of California's natural gas supply is essentially a product of oil operations, the rate of gas production is effected by the rate of oil production. The two operations being so closely related, present the country's most novel natural gas production complexity. Drilling problems are largely oil development problems as the dry gas portion of the total supply is produced from a comparatively small number of gas wells. The whole matter of gas supply is one that taxes the ingenuity of the two industries at times and compels close coordination of effort, especially under war conditions.

Viewed in a broad sense, the natural gas industry development problem, except as it is influenced by variations in the supply of casinghead residue gas, appears to sum up about as follows: An analysis of government statistics shows that for the five-year period, 1937 to 1941, inclusive, nine hundred and ninety-two new dry gas wells were completed for each trillion cubic feet of natural gas utilized and marketed. A recent report of the Texas-Mid Continent Oil and Gas Association contains an estimate which places the total of all marketed natural gas for the year of 1942 at approximately three trillion four hundred billion cubic feet. Accepting this estimate and using the five year average drilling experience per unit of volume marketed, the industry might reasonably have completed three thousand three hundred and seventy-three new gas wells during 1942 to offset the decline in the available supply, instead of the total of two thousand and eighty-nine, actually drilled which was about forty per cent less than the indicated need.

Vital Construction Requirements

The second phase of the gas supply problem, like the ever-present requirement to drill new gas wells in productive areas, is that which arises through necessity to augment the gas supplies of partially depleted fields where development is no longer practicable. This may resolve itself into

(Continued on page 230)

National Advertisement Features Huge Gas Holder

THE gas industry applauded when the April 10 issue of *The Saturday Evening Post* appeared with a remarkable full-page advertisement of Crane Valves paying tribute to the industry. Under an artist's drawing of a tremendous gas holder, the advertisement (reproduced below) asks "Is this enough gas for the U. S.?" The copy, which is noteworthy, reads in part as follows:

"How big a holder do you think it would take to hold all the gas this country uses in a year? The one pictured above would do it. But it's an impossible size—more than four miles high by two and a half in diameter.

"Yet it would take this imagined monster to hold the more than 3 trillion cubic feet of heating and illuminating gas the United States consumed in a single pre-war year.

"Three trillion! Even in this day of box-car figures, that one defies comprehension. Let's take it apart. The average home uses about 24,000 cubic feet per year for cooking. Even when you add all home uses—both for cooking and for house-heating—you still have but a fraction of the huge total.

"Petroleum refining—cement making—the public utilities—all gobble up tremendous volumes of gas. Steel, glass, prepared foods: their makers would close down if gas were denied them. Fact is, it's pretty hard to think of an industry which doesn't need gas—and lots of it.

"Yes, gas is definitely big business in this country. Getting it out of the ground—or making it—transporting it hundreds of miles across country—distributing it to virtually every building in every city. This is one of the unsung but very real marvels of our age.

"It's a marvel of flow control, the kind of flow control accomplished through Crane valves. For gas must be tamed to be useful and Crane valves do much of the taming."

Reproduction of full-page advertisement in *Saturday Evening Post*.

Reproductions of the advertisement were distributed by the American Gas Association to delegates of member companies.

Teaching Customers . . . *To Do Things for Themselves as an Aid to the War Effort*

By DONALD S. BITTINGER

Supt. of Service Department, Washington Gas Light Company, Washington, D. C.

SUCCESSFUL teaching involves the creation of interest for the student and a clear, effective presentation by the instructor. The Government's job training program uses as a motto "If the worker hasn't learned, the instructor hasn't taught." Our chief concern in educating customers to do things for themselves should be: How to create that interest! and: How to present a concise, educational program in an economical manner to the extent that it continues to benefit the utility and retain the interest of the customer!

Help-Yourself Service

You may have heard of the young housewife who was watching a serviceman gassing out, adjusting all appliances and showing how to take care of the equipment. When observing the serviceman take a statement of the meter, the new householder said "We are learning to do things for ourselves. I know you will be glad to know you won't have to bother reading the meter any more as my husband has invented a new gadget that prevents the meter from registering." We might say that such is an example of an educational program having been carried too far to be of benefit to the utility.

Then there was the college professor who prided himself on his elocution and who was lecturing before a class when he noticed a student in the front row slumped down in his chair, breathing through his mouth, and apparently fast asleep. This shocked the professor's pride and he immediately swung into an oratorical discourse on the lackadaisical attitude exemplified by some of the younger generation. He wound up his tirade by calling attention to the example of the young man in the front row who seemed fast asleep, by saying "For instance, look at George there, sound asleep when he could be learning." There was a pause while the class contemplated the reclining student; when without changing position and barely opening one eye, supposedly sleeping George mumbled "I wish the hell I was." Too frequently in the past this has seemed to be the attitude of many customers when a company was attempting to execute an educational program. Instruction by a utility involves most of the fundamentals and, sorry to relate, most of the problems of other types of teaching.

However, if we can determine how and to what extent such a program should be carried on, if we can be sure we are retaining the interest of the customer, now is the opportune time to foster such a project as an aid to the war effort. We have found in Washington that customers seem particularly interested and willing to cooperate because they want to do their share by helping us to save gasoline, rubber, time and material.

Intensive House Heating Campaign

The Washington Gas Light Company's instruction activities began for house heating as early as 1933, but did not take intensive form until July of 1940, when the number of house heating customers on the lines of the Washington and nearby Maryland companies had grown to 29,000, an overall average increase of 28% per year since 1930, the year which marked our first real promotional effort. Our company had undergone a sad experience in the fall of 1939 when a cold wave coincided with the usual "Moving Day" around October 1st. All incoming telephone lines were literally "jammed" most of the day and night and the company found it impossible to give service to some customers until several days after the original call. It became apparent that an intensive campaign was necessary.

In order to begin that intensive campaign, all house heating customers were recorded on Hollerith (or I.B.M.) punch cards and sorted by make and model. This information was later transferred to an addressograph file and kept in route and account number order. After a training course, a crew of 14 men with sales experience, supervised by one of the sales department representatives, was taken to a particular area of the city and dispatched with orders and instruction booklets.

House-to-House Canvass

These men executed their orders by a house to house canvass of the locations called for on their orders. Explanation and demonstration was given to the customer and the instruction booklet wired to the gas supply line or somewhere near the furnace. If the owner or person who took care of the furnace was not at home, the booklet was always left wired near the heating equipment. In many instances a second call was made by appointment to instruct the man of the house. The address is always plainly marked on the face of the instruction booklet so that in the event of new occupancy, the new owner or tenant will realize the booklet applies to that particular heating equipment.

This instruction crew was carefully trained in the operation of a particular make and model of house heating equipment. The crew executed the orders of the most prevalent make and model as a separate group. Progressively, a different type house heating appliance was added to the instruction crew's work until ultimately orders for many different makes and models could be routed and dispatched to-

Presented at A. G. A. Distribution Conference, Cincinnati, Ohio, April 29-30, 1943.

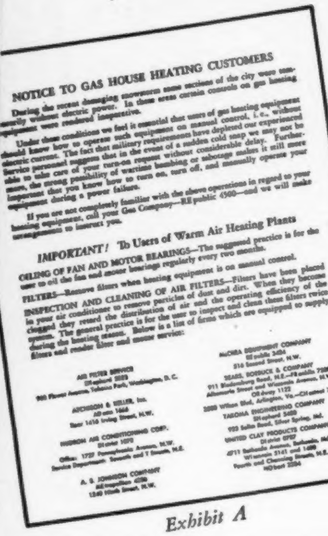
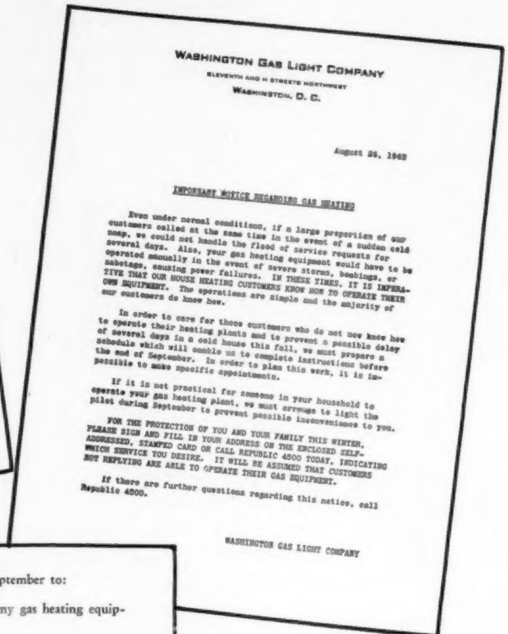


Exhibit A



WASHINGTON GAS LIGHT COMPANY
ELEVENTH AND H STREETS NORTHWEST
WASHINGTON, D. C.

August 24, 1942

IMPORTANT NOTICE REGARDING GAS HEATING

Even under normal conditions, if a large proportion of our customers called at the same time in the event of a sudden cold snap, we could not handle the flood of service requests for several days. Also, your gas heating equipment would have to be operated manually in the event of severe storms, bombings, or sabotage, causing power failures. IN THESE TIMES, IT IS IMPERATIVE THAT OUR HOUSE HEATING CUSTOMERS KNOW HOW TO OPERATE THEIR OWN EQUIPMENT. The operations are simple and the majority of our customers do know how.

In order to care for those customers who do not now know how to operate their heating plants and to prevent a possible delay of several days in a cold house this fall, we must prepare a schedule which will enable us to complete instructions before the end of September. In order to plan this work, it is impossible to make specific appointments.

If it is not practical for someone in your household to operate your gas heating plant, we must arrange to light the pilot during September to prevent possible inconveniences to you.

FOR THE PROTECTION OF YOU AND YOUR FAMILY THIS WINTER, PLEASE SIGN AND FILL IN YOUR ADDRESS ON THE ENCLOSED SELF-ADDRESSED, STAMPED CARD OR CALL REPUBLIC 4500 TODAY, INDICATING WHICH SERVICE YOU DESIRE. IT WILL BE ASSUMED THAT CUSTOMERS NOT REPLYING ARE ABLE TO OPERATE THEIR GAS EQUIPMENT.

If there are further questions regarding this notice, call Republic 4500.

WASHINGTON GAS LIGHT COMPANY

Please send your representative during September to:

☐ give instructions in the operation of my gas heating equipment.

☐ light the pilot, since it is impracticable for one of my household to operate the gas heating equipment.

Name ....

Address ....

Phone Number ....

Exhibit B—Letter and enclosure (left) sent to customers during intensive house heating instruction program

gether as the personnel of the instruction crew gained experience. Some 13,500 orders were completed in a little over three months' time at a cost of approximately 65c each, including all training, time, material, and transportation.

Eight different instruction booklets have been designed, each including instructions for manual operation in the event of power failure. Some are designed so that the single booklet may be marked for use on any one of several makes and models. The elimination of only one turn-on or turn-off request more than justifies the expense of teaching one particular customer.

This intensive house heating instruction program has been followed up by calling the customer's attention to the advisability of knowing how to care for his house heating equipment. A letter to customers August 28, 1941, related newspaper advertisement of September, 1941, a notice inserted in bills of April, 1942 (Exhibit "A"), and a letter August 24, 1942 (Exhibit "B"), were successive steps following up the original instruction program. Also servicemen carry a copy of each of the different instruction booklets and are supposed to give a customer instructions on any service call or on voluntary inspections. Manual operation is always included in instructions. I am glad to say that by now, on the periodic inspection of all house heating equipment, the men in the field find an instruction booklet on the vast majority of premises.

Since Pearl Harbor, of course, we have become more conscious of the need for teaching customers to do things for themselves on appliances other than house heating. The National Emergency made it necessary for us to alter company policies so that requests for service are executed on the same day only if the call is of an emergency nature, such as a leak, no hot water where there is a baby or illness in family (no implication that "Baby" and "Illness" are synonymous), or no heat in severe cold weather, etc.

The Telephone Service Bureau, which receives all customer service calls, has done a good job in educating customers entirely by telephone to expect this less-prompt service. No radio or newspaper announcements have been made. The public received the curtailed or delayed service in a very co-operative manner and became more conscious of the advantages of knowing their appliances and how to operate them. The Telephone Service Bureau also assists the customer in handling minor services which the average consumer should know how to do. For instance, frequently the customer who has been previously instructed in the operation of house heating equipment, may call to ask questions concerning the lighting procedure. The Telephone Service Bureau man will go through the instruction booklet step by step with the customer.

Telephone Service

Assistance is given by phone in turning off all appliances, and in summer operation, oiling motors, and cleaning filters for warm air equipment. The Telephone Service Bureau may give suggestions for cleaning ranges inside and out, lighting or turning off refrigerators, when to defrost, how to keep trays from sticking, etc.

No instructions are given by phone for a major servicing operation. This spring the Telephone Service Bureau expects to handle the majority of those requesting the turn off of house heating by instructing the customer by phone how to turn off his own equipment. For the first three months of this year compared to last, the number of requests for service have decreased 29% and the number of completed orders have fallen off 40%.

In newspaper advertisements and bill inserts, the general theme has been one of gas conservation. However, mention is usually made of the necessity for keeping all gas equipment in good operating condition (Exhibit "C"—newspaper, and Exhibit "D"—bill insert). The small folder for commercial customers, entitled "Keep 'Em Cooking" (Exhibit "E", prepared by A. G. A. Committee), stresses the importance of knowing something about equipment and keeping it in good condition. These were distributed to commercial customers at a combined meeting of

the Bakers & Restaurant Association.

Voluntary commercial service inspections have been somewhat curtailed but not discontinued, as the demand on commercial cooking appliances in Washington is very heavy. A "Maintenance Chart for Gas Cooking Equipment" was mailed out to commercial cooking customers. This chart gives the manager or chef very good instructions on the proper care of commercial appliances.

The company also sponsored a regular commercial radio program and in many of the "Commercials" or "Plugs" introducing and closing these radio programs, reference would be made to the "Home Volunteer's Defense Manual," and the listener was invited to pick up one of these booklets free of charge at the company offices. This little booklet was published by Servel, Inc. In addition to covering nutrition suggestions and the use and care of the gas refrigerator, it gives in a clear, concise manner, useful household hints for taking care of the range and water heater.

While the listeners interest in this Home Volunteer's Defense Manual may be aroused by nutrition, the utility accomplishes something on "Teaching Customers to Do Things for Themselves as an Aid to the War Effort" through the section on "How to Make Your Household Equipment Last Longer." Also, on January 6, 1943, a woman who conducts a Home Forum interviewed the superintendent of the service department on the care of the household gas equipment. The company is at the present time sponsoring a broadcast pertaining to Victory Gardens, three times a week, and is participating locally in the national hook-up program "Fashions in Rations." Care and operation of equipment has been and will be stressed from time to time in the introductory and closing announcements.

Another form of attempting to reach the general public on the importance of taking care of equipment themselves,

Exhibit C

Exhibit D

Exhibit E

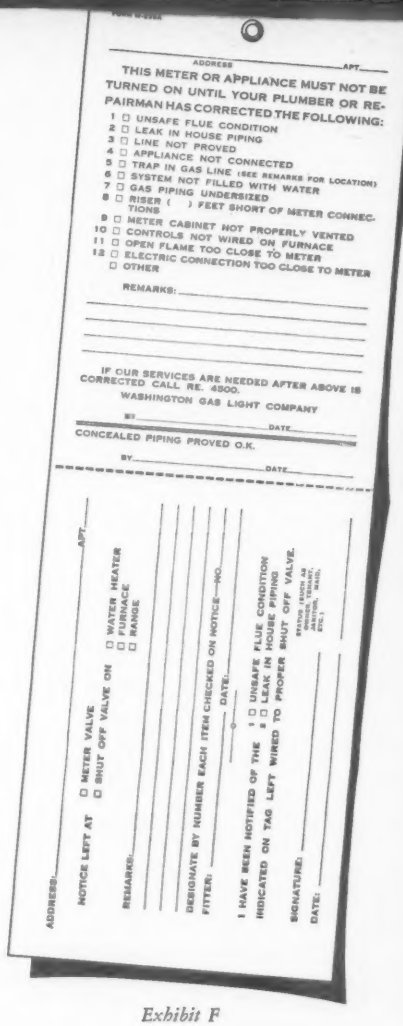


Exhibit F

has been through the medium of talks before organization of one kind or another. Whenever opportunity presents itself, the company has its representatives talk before various groups of the OCD organization, home maintenance and repair groups of the American Women's Volunteer Service, and the Washington Restaurant Association.

The Home Service Committee of the A. G. A. has published a pamphlet "Uncle Sam Wants It to Last." This pamphlet, forwarded by our home service department to the food and home economics departments of radio stations and newspapers, has been used from time to time as a source for household hints to be included in programs and newspaper articles. Some of the range manufacturers have published instructions for adjustment and care of the range, which can be

used to advantage for that appliance.

For some time our company had been calling the attention of customers to certain things which should have been done to improve the utilization of gas, only to find later as a result of another service call that nothing had been done in response to recommendations. The person advised frequently forgot to pass the word along to the owner, or the message was inadvertently altered. We designed a form which has proved very valuable in calling the customers' attention to conditions to be corrected; a Pink Notice tag (Exhibit "F").

This form is filled out by the serviceman and left at the appliance or at the meter as a notice to the customer that some condition should be corrected. The tag has a stub which is filled in and signed by the customer for deficiencies which we believe may result in an unsafe condition. When the customer signs one of these stubs as an indication that he has been duly notified, the stub is returned to the office and a letter is sent by the commercial manager to the person in whose name the gas account is carried, as further assurance that the customer is notified of work which should be performed. Generally, the customer reaction to this notice has been good and we have received many letters of thanks for calling these things to the householder's attention.

Air Raid Defense Tie-in

Some of you will naturally wonder how these different methods of "Teaching Customers To Do Things for Themselves as an Aid to the War Effort" tie in with the Washington air raid defense activities. This company has not gone into wholesale instruction for the purpose of having customers take entire care of themselves in the event of an air raid. We have, however, conducted an employee training program wherein members of the non-operating departments of the company and the clerical force have been instructed in turning off and turning on gas to a premises. Some 200 employees are trained.

OCD instructions have informed the public that no attempt should be made to shut off the main gas supply unless the house is badly damaged, and that if the "main gas valve is turned off for any reason, do not turn it on again yourself. Call for a trained man." However, the recent "Notes on City Gas for Air Raid Wardens,"† published by the United States Office of Civilian Defense, in addition to instructions to air raid wardens includes a section on "Typical instructions furnished to gas company customers who are competent to turn on their own gas." This section covers the sequence of steps to be taken in restoring gas service to premises, but winds up by stating that if the customer is not "entirely certain and familiar with the method of lighting and operating your gas appliance, call on the services of a plumber, gas company employee, or some other qualified person to turn on the gas."

As mentioned before, we have not attempted to instruct the public on how to shut off or restore service following an interruption due to air raid damage, but it is believed that our efforts to assist the customer in becoming familiar with his equipment and thereby enable him to do things for himself under normal conditions as an aid to the war effort, would be equally useful in the event of an emergency such as the loss of pressure in a damaged section with its consequent shut off and restoration.

No newspaper notices have been inserted asking the customer to refrain from calling the gas company for service. We felt this would be used only as a last resort in the event our Telephone Bureau was unable, through personal contact, to reduce selectively the number of calls. They have succeeded so well, we still see no reason for paper publicity. We did broadcast on the coldest day last winter, asking the customers to conserve gas, set the thermostat back to 60°, and use only one top burner on the range. We have also mailed out requests for thermostat settings carried by customers at different times of day. The replies were used to assist us in our annual distribution load study. Customer response to both has been exceptionally good. As a matter of fact, after the broadcast on the cold day, some customers called to ask if we wouldn't like them to postpone washday or if it was all right then to set the thermostat up to 65°.

Many Information Channels

The various methods sketched briefly here are not given with the implication that Washington practices are a criterion for a customer education program but rather to afford some indication of the many possible channels which may be used. We would appreciate receiving ideas from other companies.

Despite the fact that the metropolitan area of Washington is a boom town with an estimated population increase of over 300,000 since the 1940 census, total completed orders for the first three months of this year compared with the same period a year ago have decreased 40%, of which Services on Customers' Premises fell off 37%. We give a great deal of credit for this decrease to the general psychological reaction of cooperating with the war effort yet we can't help but feel that we have contributed to that reaction by repeated and different approaches to customer education.

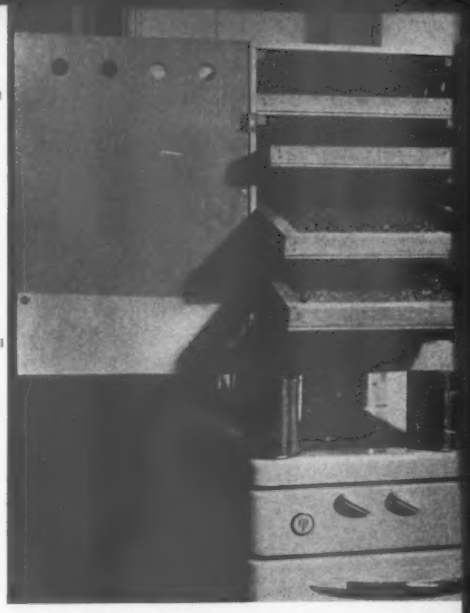
Food Jar Exhibit

This exhibit of a variety of jars and closures has been set up by the Washington Gas Light Company as a service for women customers who may not understand the use of new wartime canning supplies. Metal and rubber having gone to war, a processed rubber is used in the new Victory rubber rings with no lips. Jar openings are smaller—and glass tops, in the main, replace zinc caps

†Based on information prepared by the American Gas Association.

Preserving Foods by Drying with Gas

Contributed by HOME SERVICE DEPARTMENT
Rochester Gas & Electric Corp., Rochester, N. Y.



Homemade food dryer set up in Rochester which corresponds roughly to the unit sketched below. Legs are made of empty tin cans. The trays contain carrots, corn and spinach

A progress report containing preliminary findings of a food preservation method that has gained prominence as a direct result of war demands.

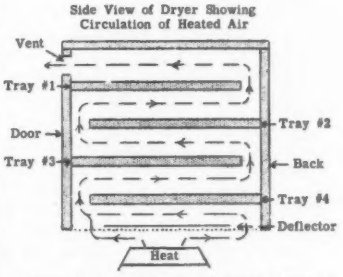
•

DRYING has proved to be a satisfactory method for preserving many foods. Although much work remains to be done, results have been acceptable for several types of food. The food value of the dried products has not been entirely determined, but it can be retained to the best extent if the proper methods are followed. The methods used and the inspiration for the work done in Rochester were derived from a demonstration for leaders of 4-H Club groups, given by Mrs. Inez Prudent of Cornell University. The homemade dryer used was also patterned after the one demonstrated by her, according to specifications given in a Cornell University drying publication.

In order to help retain the food value, blanching of vegetables is an important first step. This is done either by steaming or by immersion in boiling water, but the steam bath, using a steamer or a wire basket with a large pan, is to be preferred. The length of time varies from 3 to 12 minutes, depending on the vegetable to be dried. The food is then spread on racks and placed in the dryer or the oven.

The preparation of fruits involves allowing the halved or sliced fruit, such as apples or peaches, to stand in salt water, using one tablespoon of salt to one quart of water, while they are being prepared in order to prevent darkening. The apples which were dried showed excellent results in respect to color. Sulphuring is sometimes recommended to preserve color and Vitamin C, although it encourages the destruction of Vitamin B_1.

Fruits or vegetables are cut into pieces according to the most desirable size and shape for use. Thinner pieces dry more quickly and, in the case of thin lengthwise slices of carrots, seemed to retain their color better than when sliced more thickly crosswise. Apples were sliced one-fourth inch thick or cut in one-fourth inch rings; prunes and peaches were halved; green peppers and celery were diced; and corn was either left on the cob or cut off, the latter involving a quicker drying time and less storage space. The variety of fruit should be chosen with its drying qualities in mind, as a drier type of peach, such as Southhaven or Alberta, gives a better product, and a winter apple, such as a Northern Spy, is better than a juicier summer variety.



(From U. S. Department of Agriculture Victory Garden Leaflet No. 5)

Sketch of homemade dryer which is 14" wide by 20" deep and 19" high, excluding the legs. Materials needed are: wooden packing case or waste lumber, mesh metal cloth, staples, nails, hinges, door fastener, and four tin cans for legs

There were two methods used, the homemade gas dryer, mentioned above, which was placed over two top burners of the range, and the oven. The latter proved to be a quicker method, but in trying the high temperature of 250° F. we found that carrots discolored quickly even before they were thoroughly dried, during the two-hour period in which they were left in the oven with the door closed. It might be advisable to have the oven on one hour, off one hour, then on one hour longer. The foods were also allowed to stand an additional two hours with the door open and the heat turned off. The racks were covered with paper towels or cheese cloth, leaving a space of about two inches on all sides to facilitate circulation of heat.

The top-stove dryer gave more colorful results over a four and one-half hour period over two very low sim-

mer flames. The temperature within the dryer was gauged by a thermometer inserted in the side, and was gradually increased from 130° F. to 170° F. by turning up the burners slightly. The food was checked at approximately one hour intervals, stirred and turned occasionally; the racks were shifted two or three times during the process. The dryer used about twice the amount of gas as the oven for the same weight of carrots. This was by no means a capacity load for either the dryer or the oven, but the figures are shown below in table form:

	Weight of Carrots Before Drying	*Drying Time*	*Amount of Gas (549 B.t.u. Gas)*	*Weight of Carrots After Drying*
Gas Dryer	2 lbs. 2 oz.	4¼ hours	41.7 cu.ft.	4 oz.
Oven	2 lbs. 2 oz.	2 hrs. gas on 2¼ hrs. gas off	23.4 cu.ft.	4 oz.

It took 4 cubic feet of gas to blanch the 2 lbs. 2 oz. of carrots.

The speed of the drying process depended on the amount of food in the trays as well as the thickness of the pieces. Trays may be piled up to ¾ inch thick with food, but will require more turning and more shifting as well as a longer period of time.

Before the food is stored it should be thoroughly dried, and if it is done in humid weather or surroundings and shows signs of moisture after a day or two, it should be reheated. Before storing, it should be left in large containers where the air can circulate through it and evaporate any last traces of moisture. Then it should be stored in tightly covered containers, preferably of the same size as the amount of food to be stored to prevent deterioration by air, and the covers may be sealed with a layer of paraffin. Deterioration in color and flavor of foods not stored under optimum conditions was marked after two months' time.

Drying seems to be a useful method of preserving foods for which canning facilities are limited or to prevent waste of small amounts of food. Aside from corn, prunes and perhaps green peppers or celery according to individual use and preference, the advisability of drying a large quantity of food is questionable from the point of long time storage and its effect on color, flavor and food value. Other foods which were dried successfully were apples, peas, parsley and spinach. Green beans were the least successful of the vegetables dried. Spinach and carrots seemed more like the fresh vegetables than the same vegetables canned. Drying does, however, form a most satisfactory supplement to canning.

U.G.I.—Granddaddy of All Public Utility Holding Companies

ONE of the landmarks of the utility industry, the United Gas Improvement Company, is described in an interesting historical article, "The Granddaddy of All Utility Holding Companies," by M. R. Kynastoff which appears in *Public Utilities Fortnightly* for April 15. Monumental contributions of this company to the development of the gas industry are presented on the eve of divestment of certain securities and assets under the Public Utility Holding Company Act.

Pointing out that U.G.I. was "the original public utility holding company" Mr. Kynaston traces the reasons for its organization and growth to show the important role it served in developing utility service. The following historical, financial and statistical data on this remarkable organization are set forth by Mr. Kynaston:

U.G.I. is over sixty years old, as it was organized June 1, 1882. Its initial purpose was the introduction of the Lowe water gas process, a new method of gas manufacture. Up to that time gas had been made by carbonization of coal, and water gas—as the Lowe process was commonly called—was a distinct advance in the art.

The company manufactured and promoted the sale and installation of Lowe water gas production machinery. Since its inception, U.G.I. and its affiliated companies have sold over 1,200 water gas sets, with a daily capacity of one and three quarter billion cubic feet of gas and with a value of approximately $23,000,000. There is hardly a gas plant in the United States that does not use a gas-manufacturing set based upon the Lowe patents.

The U.G.I. is credited with great assistance to the gas industry by giving it the Welsbach mantle which postponed for several years the inevitable loss of the lighting load while it was developing its cooking and heating business. Through a subsidiary —The Welsbach Incandescent Gas Light Company—the U.G.I. acquired the United States patent rights to the mantle which was invented by Carl von Welsbach, an Austrian. Some 648,000,000 Welsbach mantles were manufactured and shipped all over the world before the eventual displacement of gas as a general illuminant by electricity.

Although first exclusively dealing with gas, U.G.I. also became interested in the electric industry and acquired companies in that industry. Throughout its existence Philadelphia, the nucleus of its territory, has been the home of U.G.I., and the Philadelphia Electric Company is the largest company in this group. Since 1897, U.G.I. has managed and operated the municipally owned Philadelphia Gas Works Company.

In addition to many reductions in rates, important research work has been a valuable contribution of the company to the public welfare. Starting with the development of equipment for the manufacture of water gas, and continuing with the refinement of this as well as the coal gas process, many advances in the art have been the result of intensive research fostered by U.G.I.

Research Developments

Of the more outstanding developments in recent years are the U.G.I. process for using heavy oils in the manufacture of carburetted water gas, its process for the reforming of high B.t.u. hydrocarbon gases into gases suitable for mixture with ordinary blue gas, and its process for producing in carburetted water gas sets a substitute for natural gas with a B.t.u. content approximating the latter.

A major contribution to the country, as a direct result of its research occurred at the time of our entrance into World War I when U.G.I. gas plants were said to be the only ones in this country prepared to produce toluene, an essential in the production of explosives. The company's experts were loaned to the government for the purpose of developing a program to meet the country's requirements of this necessary ingredient in the manufacture of TNT. These experts were largely instrumental in the development of the process used to produce toluene from kerosene, in this manner providing the Ordnance Department with an unlimited supply.

For the past several years research activities of U.G.I. have been directed towards a better utilization of the chemical possibilities of water gas tars and their light oil constituents. This has resulted in the development of new and highly specialized petroleum-cracking processes for the production of numerous strategically important hydrocarbon intermediates from crude oil in addition to the usual fuel products.

William W. Bodine is president of the company which today has assets in excess of $332,000,000.

Gas Summer Air Conditioning

Trump Card of the Gas Industry in the Post-War Era

By H. P. MOREHOUSE

Public Service Electric and Gas Co., Newark, N. J.

H. P. Morehouse

THE scramble for post-war markets for heat energy will be tremendous. Every gas company will have to fight not only for new and expanded markets but to retain its place in the fields which in the past have been complacently considered its rightful domain.

Gas refrigeration has served the industry well for 16 years by being the Glamour Boy which furnished a necessary dramatic appeal. For nearly 20 years automatic gas heating has been the industry's spearhead which reflected the modernity of gas. Largely through the influence of intensive sales promotion of these two services gas has been kept in the public eye as a modern servant in the home.

In the post-war era the gas industry will be badly in need of a new Leading Man who can carry on and capture the public's fancy. The gas industry is fortunate in that it not only has such a load possibility but also that this load is one of the most ideal imaginable from the standpoint of manufacture and distribution peaks. This new load is Gas Summer Air Conditioning.

In order to determine the characteristics of this load and to help evaluate its future possibilities in the New Jersey climate, Public Service Electric and Gas Company installed a year 'round air conditioning unit in the home of Mr. and Mrs. D. C. Hungerford at Madison, N. J. The unit was installed under an arrangement with the customer whereby we were allowed to collect data throughout the Summer of 1942.

The house, a picture of which is shown above, has nine rooms, four baths and spacious halls. There are two people and a maid in the household.

The house was under construction during the Spring of 1942. Unfortunately the duct system was in place before the decision was made to install the year 'round unit. This fact restricted our heating layout to some degree. The most important changes called for an enlarged plenum chamber and the extension of the supply risers on the 1st floor so that we could use high supplies during the cooling season and low supplies during the heating season.

The unit selected was the 5-ton Servel conditioner. Because of the absence of a city sewer and also because of the high water cost, the unit was installed with a water tower. The actual cost of the installation is tabulated below.

The conditioner has the equipment for both heating and cooling housed within the one jacket. The system is the indirect warm air type where atmospheric steam is supplied to a heating coil in the warm air stream. The cooling equipment is the absorption type using water as the refrigerant. For those who are not familiar with the operating of the Servel unit, a brief description of the cycle follows:

Referring to the schematic diagram, Figure I, we find in the cooling cycle seven main divisions, viz: gas-fired boiler, generator, separator, condenser, cooling coil, absorber and heat exchanger.

The boiler is of the conventional fire tube type. It operates on open vent and supplies vapor at atmospheric pressure to heat the generator. In the generator is a solution of lithium chloride

Air Conditioning Unit (at cost)	$1160.00
Water Tower (at cost)	263.00
Setting up Equipment, Special Grilles and Sheet Metal Changes	391.86
Plumbing and Carpenty Work	70.60
Miscellaneous Items	38.88
	$1924.34

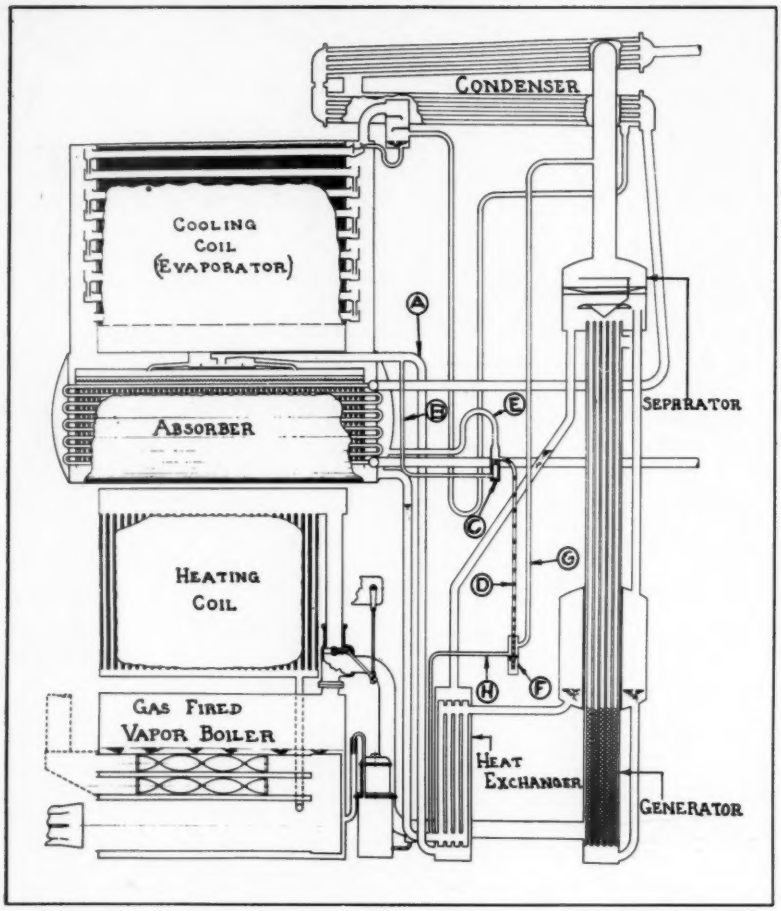


Figure 1. Schematic diagram of Servel air conditioner cycle

in water, water being the refrigerant and lithium chloride the absorbent.

The whole cycle operates under a vacuum. The refrigerant and absorbent are driven from the generator to the separator where a strong solution of the absorbent separates out and returns through the heat exchanger to the absorber.

The refrigerant (now a vapor) passes up through the condenser where it is cooled by the water from the cooling tower. When the refrigerant leaves the condenser it is in liquid form. It passes through a U-tube seal and into the cooling coil where it evaporates, taking up its heat of vaporization from the room air which is blown over the cooling coil.

The vacuum in the evaporator is increased by the action of the absorber which is just below the evaporator. Lithium chloride has a great affinity for the refrigerant and draws it rapidly down into the absorber. To get intimate contact and increase the suction on the evaporator the absorbent is sprayed into the space through which the refrigerant drops.

The mixture of absorbent and refrigerant now flows back through another passage in the heat exchanger and into the generator where it starts on another cycle.

On the heating cycle the gas-fired boiler delivers vapor to the heating coil shown in the schematic diagram just above the boiler.

The arrangement of the air cycle is shown in Figure IV. Return air from the rooms flows first through the filters and (in summer) over the cooling coils through the (wide open) restrictor damper and through the fan to the supply duct system. On the winter cycle the air, after passing through the filters, flows over the humidifier pans and through the restrictor dampers which are now partially closed automatically. This reduces the winter air quantity to two-thirds of the summer flow in order to avoid drafts. The air then passes over the steam heating coils to the fan where it is forced out into the supply duct system.

The entire operation of the unit from summer to winter and vice versa is controlled by the customer from the wall-mounted thermostat. There are three toggle switches on top of the thermostat which allow the user to choose whether he wishes Heating, Cooling or only Ventilation. The user also has control over the temperature he desires on either the summer or winter cycle.

The customer moved into the house during the week of June 1. We started to collect data for the week of June 8. During the first week of the test carpenters and mechanics were putting on the finishing touches to the house with the result that doors and windows were often left open so that the data collected during this short period is not reliable. The test ended on September 18 which was the last date cooling was required.

Thermostat Left at 74°

If the owners had operated the system in the usual way by changing the thermostat whenever they desired, it would have been more difficult to interpret the accomplishments. We therefore requested that the thermostat be left at 74° unless extremely high outdoor temperatures made this undesirable. As a result we have a definite measure of the work the equipment was called upon to do and what it actually accomplished.

A standard weather bureau station was set up for continuous recording of outdoor temperatures and relative humidities. A similar instrument was set up in the study on the first floor. By comparing the recording charts of these two instruments we could demonstrate what the air conditioner was accomplishing each hour of the day and night.

Instruments were installed to measure the number of hours the unit was in operation during the day and during the night. This was still further broken

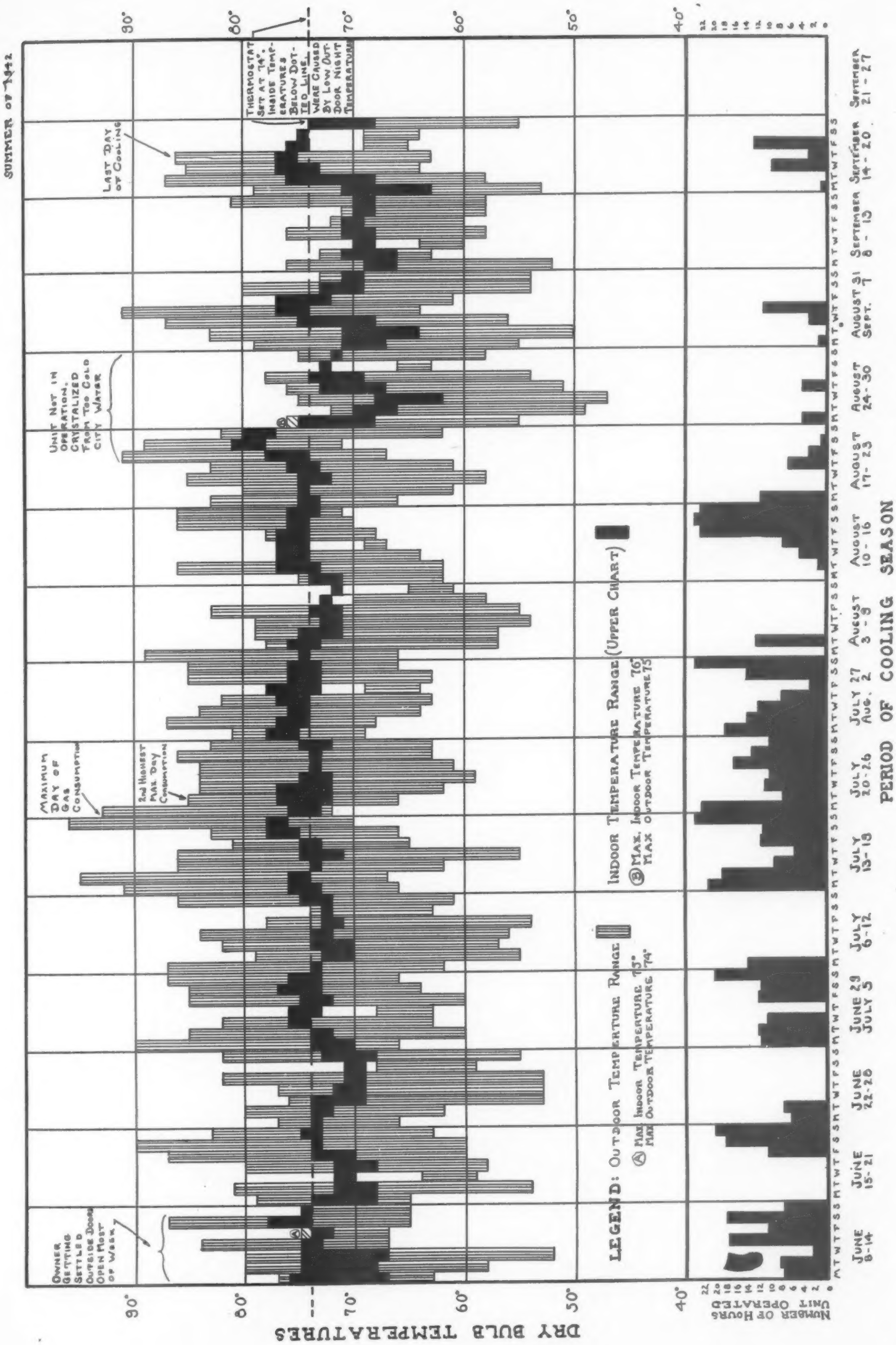


Figure 2. Daily indoor and outdoor temperature range and corresponding hours of unit operation

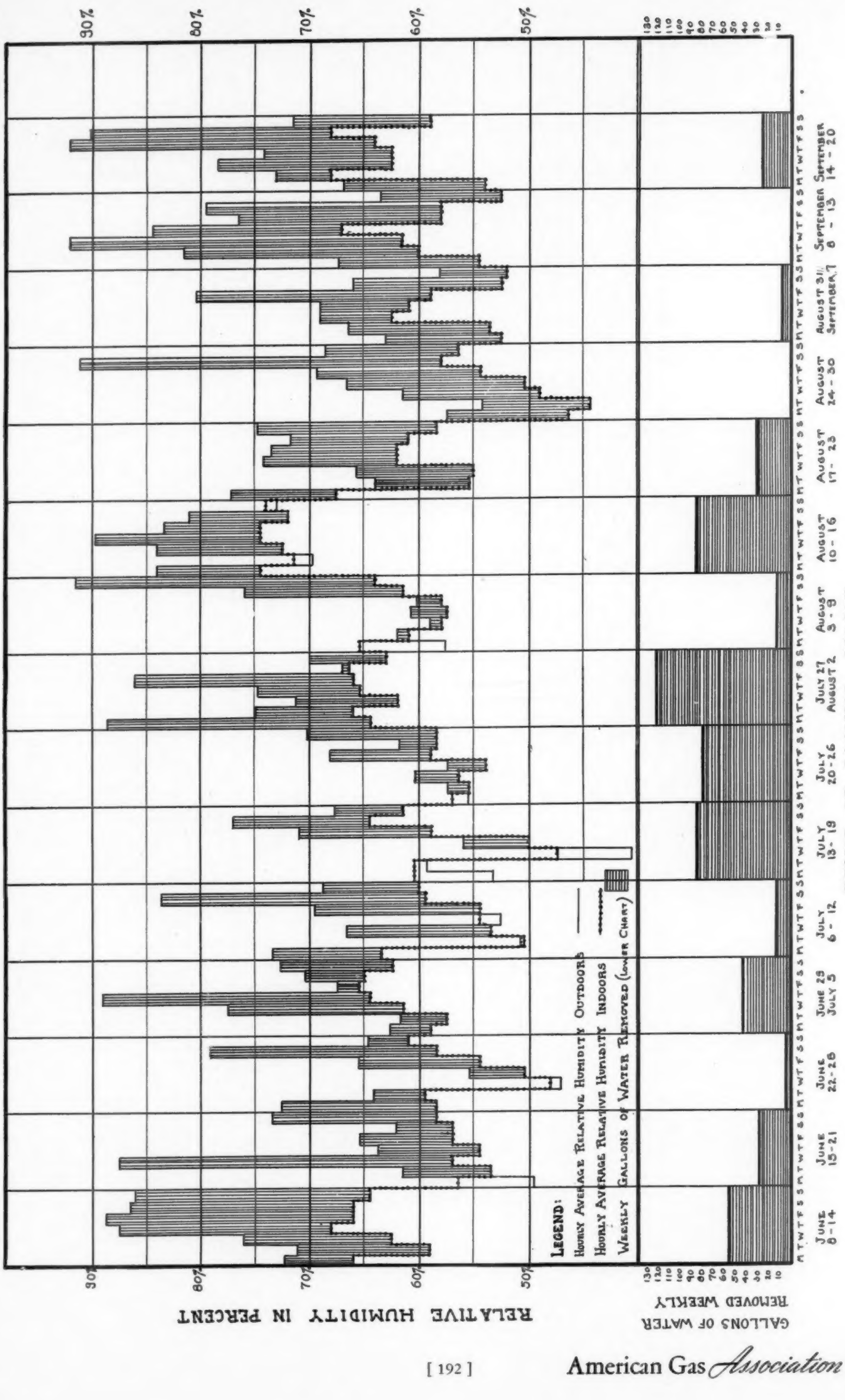


Figure 3. Daily indoor and outdoor relative humidity range and corresponding weekly gallons of water removed

down into 1st and 2nd stage of operation (high and low gas input).

The chart, Figure II, shows the effectiveness of the unit in lowering temperatures. The temperature, humidity and weather data for every day during the summer were recorded.

The daily hours of operation have been plotted at the bottom of the chart, Figure II. It will be observed that during certain outside temperature conditions the unit did not operate even though the outside temperature was higher than the inside. This was due in part to the fly-wheel effect of cool night temperatures the previous night and in part to the good thermal insulation in the walls and ceiling. In order not to have the conditioner appear to take credit for something it did not accomplish we have plotted a graph of the hours which the unit operated on the chart corresponding with the outdoor and indoor temperatures.

The air conditioner and water tower operated for a total of 714.8 hours. The day (6 A.M. to 6 P.M.) and night (6 P.M. to 6 A.M.) periods of operation were nearly equal. The day hours were 400.4 and the night hours were 314.4.

Improvement in Humidity

Indoor and outdoor relative humidities are plotted in Figure III. An indication of the improvement in humidity conditions indoors over outdoors is demonstrated by the cross-hatched areas between the two curves.

An interesting angle of this part of the test was the amount of water that was removed from within the house. All water removed by the unit was collected and measured. It amounted to the considerable total of 616.5 gallons for the season. The highest week was from July 27 to August 2, when 123.0 gallons were removed. The actual gallons removed each week from the air within the house is shown at the bottom of the relative humidity chart, Figure III. We believe this is the first time such information has been collected and from the user interest standpoint it turned out to be the result that seemed to make the greatest impression.

A gas meter was installed and the weekly consumption was recorded. The total cubic feet of gas used for the cooling season was 87,370 cu.ft. of 525 B.t.u. gas. Daily readings were also taken on the gas meter during July and August to determine the maximum daily use. The maximum day occurred on Monday, July 20, and was 3,700 cu.ft. The ratio of the maximum day to the total summer consumption was 1/24.

Electric meters were installed to measure separately the conditioner use and the water tower use of electricity. The total KWH used was 1041.9 which was divided as follows: Air conditioner 430.2 KWH, water tower 611.7 KWH.

If the water tower had not been used the electric cost would have been considerably less, but the water cost would have been proportionately higher.

Free from Service Trouble

The unit was remarkably free from service troubles. The only time it was shut down for service was from August 21-30, when the lithium chloride crystalized in a portion of the cooling mechanism. This was not the fault of the unit but was caused as a result of some experimental work. We decided to try a short run using city water directly in place of the water tower. The city water was 2 degrees lower than recommended by the manufacturer and as a result the unit crystalized. We understand the possibility of this occurring on the new models has been eliminated by the use of lithium bromide instead of lithium chloride.

We experienced some trouble in making the unit quiet. Part of the noise was due to the fan on the air conditioner and part to the water tower. By the liberal use of acoustical materials we were able to reduce the noise level to the point where it was not too objectionable to the customer. We are of the opinion that more work will have to be done by the manufacturer in quieting the air conditioner fan before this unit is marketed on a large scale in the East. This should not be too difficult to accomplish as many winter air conditioners now on the market have a satisfactory noise level.

The unit maintained a very comfort-

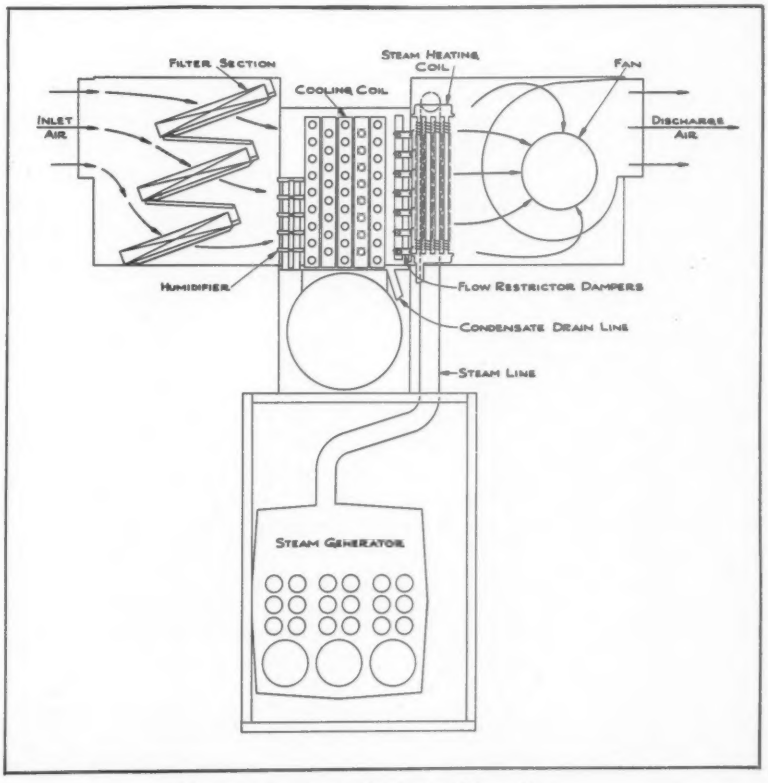


Figure 4. Air cycle in all CHA-model conditioners

able temperature and humidity condition throughout the house including the maid's quarters and kitchen. Of course, during hours when the gas range was in use the kitchen exhaust fan was usually operated to carry off the heat gain from this source.

The unit had no trouble in maintaining satisfactory temperature reduction even in the warmest weather. The hottest day was on July 19 when the outdoor temperature reached 96°. That day the unit operated approximately 24 hours and the maximum temperature reduction was 20°. This large temperature reduction is not looked upon as good general practice but does show that the unit had ample capacity.

The air at all times had a freshness that was stimulating. At no time were any of the odors present that are sometimes associated with cooling systems.

Following is a list of the utility services used and the cost of these services to the customer:

Gas—87,370 cu.ft. @ 51c per MCF		$44.52
Electric	Conditioner 430.2 KWH @ 4½c = $19.09 Water Tower 611.7 KWH @ 4½c = $27.79	1041.9 KWH — 46.88
Water—16,542 gallons @ 22½c/thousand gallons		3.74
		$95.14

This is an average of 13.3¢ per running hour of the unit. The period over which the unit operated (including the week it was out of use) was 95 days. The operating cost averaged therefore almost exactly $1.00 per day for the whole summer season.

The small cost for water ($3.74) is, of course, due to the use of the water tower. Under this method the water is used over and over and only a small amount of make-up water is needed to replace that lost in the evaporative cooling of the condenser water. Unfortunately, as mentioned previously, we were not able to get a test using city water directly through the unit to get a cost comparison.

The atmospheric conditions produced seemed to be very acceptable to the users. However, the users did feel that they would have been satisfied with less hours of operation. To put it another way they would have turned the unit off and opened the windows on certain dry cool days and nights and they would probably have been satisfied with less temperature differential during very hot weather. They willingly cooperated, however, for purposes of the test to carry a level 74° so that we could have a definite datum plane from which to measure the accomplishments of the unit.

One customer reaction that interested us in particular was the matter of high and low room supply registers. Because of the expense involved in cutting and patching we did not extend the ducts on the second floor to include high supplies. The regular low heating registers were used but we did extend all first floor supplies up the side walls so that we could use high supplies (about 6½ feet from floor) during the summer and low supplies during the winter for heating. This changeover is accomplished by simply turning off one register and opening the other at the change of season. On the second floor we were concerned lest the cold air blown along the floor would create objectionable drafts. The customer did not find this condition objectionable. One probable reason was they did not often sit in these second floor rooms.

In so far as one test case can demonstrate it, the possibilities for the future look bright in the field of Gas Summer Air Conditioning in this area. We have proved to ourselves that there is equipment on the market which functions satisfactorily and without excessive service troubles. The installation costs, while high, are not prohibitive and will no doubt be drastically reduced when the units are manufactured on a mass production basis.

We believe the operating costs from the customer viewpoint can be considered reasonable. On Public Service Electric & Gas Company rates the electric cost would have been only $30.26 instead of $46.88 on the rate available. This would have reduced the total customer cost in this case from $95.14 to $78.52 and the company's revenue for the summer cooling load, both gas and electric, would have been: Gas $44.52 + Elec. $30.26 = $74.78.

Future of Air Conditioning

AIR conditioning is only in its swaddling clothes; future homes, particularly in our own blessed land, will be maintained at constant comfort levels throughout the year. Summer air conditioning will be no more unusual than central heating and modern plumbing. Already our research engineers have installed residential, all-year gas air conditioning plants from the Atlantic to the Pacific, and New England to New Orleans. These plants bring about both summer cooling and winter heating from the same gas flame. Only the removal of war's restrictions is required to make such plants as readily available as modern gas heating plants."

—Louis Ruthenburg, President, Servel, Inc.

Potential Summer Load

Inasmuch as the Servel unit is designed to furnish both summer and winter air conditioning, the two functions cannot be separated so that just cooling could be added to an existing winter air conditioning plant. Such equipment may be developed and this would allow us to solicit the cooling load among our present 7,000 users of gas winter air conditioning. Using this installation as the basis for estimating, if such a cooling unit is devised we have a potential *summer* load of an estimated 350 million cubic feet among Public Service Electric & Gas Company's present users of gas winter air conditioning. This takes into account only the gas winter air conditioners now installed and does not include the oil-fired units.

To our knowledge there has never been a combined unit on the market which offered year 'round residential air conditioning using electric refrigeration for the summer cycle. The cost of such a unit would probably be greatly in excess of the cost of the combined Servel unit. For example, if a suitable electric refrigeration unit were added to an existing gas winter air conditioning system the cost for a 5-ton unit including compressor, fan, coil and controls, without installation,

would retail in this area for $1500 to $1800. This is for cooling only. The comparable Servel unit for both summer and winter conditioning sells to the dealer for $1160. On this basis and with a reasonable mark-up the retail costs for the gas year 'round unit would be comparable with the retail costs for just a summer air conditioner using electric refrigeration.

In comparing the operating costs for gas versus electric equipment there are two items in common to both systems. These are the water tower and the conditioner fan. We can therefore compare the gas input of the Servel with the horse power to operate a comparable electric compressor.

On an hourly basis the rated input to the Servel 5-ton unit is 100,000 B.t.u.'s. This is equivalent to 190 cu.ft. per hour of 525 B.t.u. gas. The hourly cost for this home would be 9.7¢. If a comparable 5-ton electric installation required 5 H.P., this would be equivalent to about 4.5 kilowatts corrected for efficiency and the customary overload. The hourly cost for this energy at 3¢/KWH would be about 13.5¢.

For combination utilities the favorable electric load should not be lost sight of because the electric load from the gas conditioner has a more favorable load factor than a comparable electric refrigeration system.

A comparison between the summer and winter gas load for this home may be had by analyzing the following figures:

Heating consumption (estimated) cu.ft. (103 M B.t.u. heat loss)	530,000
Cooling consumption cu.ft.	87,370
Total yearly consumption (heating estimated) cu.ft.	617,370
Percentage of cooling to total	16.4%
Percentage of heating to total	83.6%
Estimated maximum heating day—cu.ft.	5,900
Maximum cooling day—cu.ft.	3,700
Maximum hourly consumption—heating—cu.ft.	270
Maximum hourly consumption—cooling—cu.ft.	170

These figures apply, of course, only to a climate similar to Northern New Jersey. It should also be borne in mind when evaluating the above figures that the estimated peak heating day is predicated upon a zero day while the peak cooling day was an actual reading taken with a maximum temperature of 93 degrees, a minimum temperature of 73 degrees and an average of 82.5 degrees; and a maximum relative humidity of 88%, a minimum relative humidity of 32% and an average of 55.6%. We shall frequently experience warmer weather than this in which case the peak cooling day would be higher than that shown.

The cooling load has, of course, excellent load characteristics in that it is off peak. It is hardly necessary to enlarge upon the desirability of this. Any addition of summer cooling load offsets the addition of house heating load and improves the system load factor. In most cases it can be taken on with no additional plant or distribution facilities.

Operating Costs Reasonable

Certainly the operating costs should constitute no great sales resistance—we feel there must be a large number of our customers who would gladly pay $75 to $100 per summer for keeping comfortable—and the first cost is sure to be reduced as the units are produced in increasing numbers.

It is our opinion that the summer cooling load holds great possibilities for the post-war period. There will also be many prospects for comfort cooling of commercial establishments. There appears to be no reason in this area why gas cooling should not get a share of this business.

Architects will be looking for innovations when residential building starts again and summer cooling for the better homes will undoubtedly appeal to them. Of course, summer cooling will not be immediately practical for the masses but once introduced it is likely to follow gas heating trends towards embracing the lower income bracket homes. The time seems right to start laying the groundwork for its post-war promotion.

U. S. War Bonds are wings for the eagle and feathers for your nest.

Large Gas Holder Goes to War

ONE of New York City's first large gas holders is going to do its part in the war. Consolidated Edison Company of New York, Inc., announced that a gas holder at East 12th Street, Manhattan, was to be dismantled and nearly five million pounds of iron and steel made available for the war effort. This is almost the quantity of scrap necessary in building the hull of a heavy cruiser.

Title to the holder has been transferred to War Materials, Inc., and demolition started in April. The company has adjusted its gas operations so that the storage requirements at this location can be handled efficiently by two other gas holders.

The holder which will become scrap is of four million cubic feet capacity, and is of the telescopic type. In 1895, when it was built, a holder of that size was considered large, whereas now Consolidated Edison has several holders of fifteen million cubic feet capacity.

The guide frame of the holder stands 200 feet above the ground.

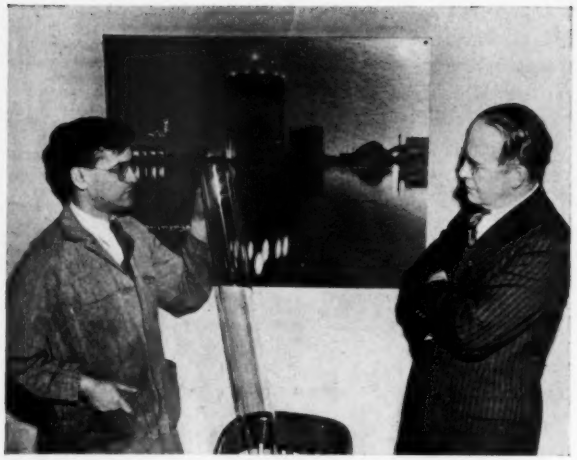
Mid-West Association Elects Officers

T. E. ROOKE, George D. Roper Corp., Omaha, Nebraska, was elected president of the Mid-West Gas Association at the annual meeting of the Association held in Omaha, April 12. Other officers named for the 1943-1944 term are: first vice-president—C. A. Bland, Iowa Power and Light Co., Des Moines; second vice-president—Burt R. Bay, Northern Natural Gas Co., Omaha; secretary-treasurer—R. B. Searing, Sioux City Gas & Electric Co., Sioux City, Iowa.

A. G. A. affiliation representatives were elected as follows: Manufacturers' Section—K. R. D. Wolfe, Fisher Governor Co., Marshalltown, Ia.; Technical Section—Lester J. Eck, Minneapolis Gas Light Co.; Minneapolis, Minn.; Accounting Section—E. H. Vieregg, Northwestern Public Service Co., Grand Island, Nebr.; Residential Section—E. J. Boyer, Minneapolis Gas Light Co.; Industrial and Commercial Gas Section—E. E. Hahn, Iowa-Illinois Gas & Electric Co.; Cedar Rapids, Iowa.

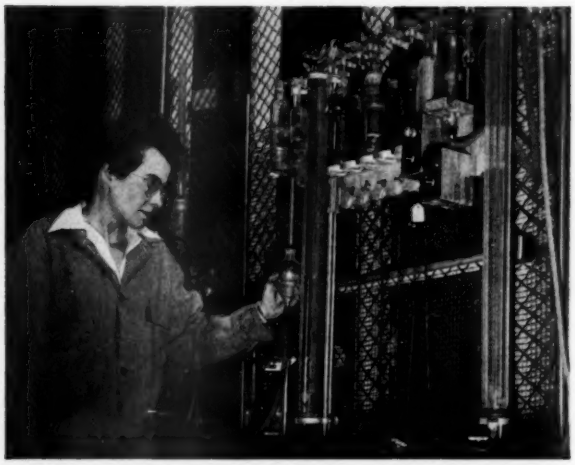
Third Major Pipeline Advocated

PETROLEUM Coordinator Ickes stated recently that a third major petroleum pipeline from Texas to the East Coast is necessary and is preferable to the proposed Florida Barge Canal. In this connection, he pointed out that the eastern section of the first pipeline is now being completed and that priorities have been granted for construction of a second major line.



Dr. Frederick W. Sullivan, Jr. (right), technical director of the Institute of Gas Technology, in consultation with Dr. S. W. Martin on the design of research equipment.

Harold Vagtborg, director of the Institute of Gas Technology (right), and Dean J. C. Peebles, of Illinois Tech, examining synthetic rubber made in the laboratories from butane.



Frances L. Estes with Fisher apparatus used in fuel gas mixtures adjusted to the needs of specific combustion operations.

A. D. Singh adjusting a hydrogenation bomb used in research on high pressure gas reactions such as reduction of hydrocarbons.

RESEARCH AT THE INSTITUTE OF GAS TECHNOLOGY

ONE of the trump cards in the gas industry's bid for supremacy in the fuel field is the program of education, research and development conducted at the Institute of Gas Technology, which is located at and affiliated with Illinois Institute of Technology in Chicago, Ill. Typical pictures of research work at the Gas Institute are shown here.

Now in its second year of operation, the Institute is already bringing the weight of scientific knowledge and research to bear on a number of fundamental problems of the gas industry, as well as creating a reservoir of finely trained technologists who will be qualified to cope with the problems of the future.

An outgrowth of action taken by the American Gas Association Executive Board in 1939, the Institute was founded with four principal objectives: the training of personnel for the industry, the prosecution of fundamental and applied research, the collection and dissemination of scientific information, and the stimulation of independent research throughout the gas industry.

Personnel training is entirely at the graduate level, leading to the Master of Science and Doctor of Philosophy degrees. The student body consists of specially selected, full-time students of high caliber, all holding fellowships.

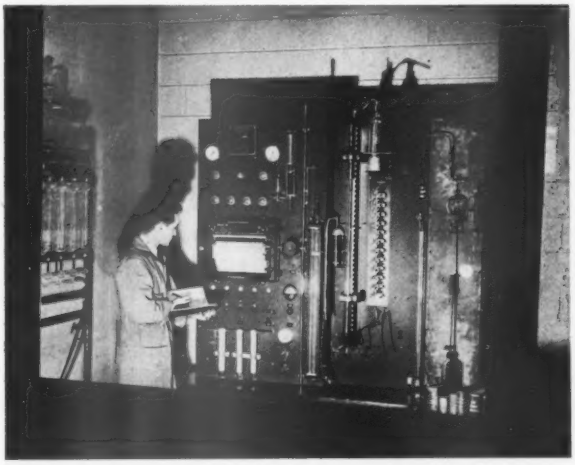
Research at the Institute includes not only that on basic problems of the industry, supported by membership funds, but research sponsored by individual members or allied industries, research by staff members, and student research for advanced degrees.

As pointed out by Director Harold Vagtborg, some of the projects now under way have a direct bearing on wartime production problems, illustrating the gas industry's basic contribution to the fabrication of materials and development of facilities needed by all industry in peace and by the armed forces in war.

Work of the Institute is directed by a Board of Trustees of 22 members headed by Frank C. Smith, president, Houston Natural Gas Corp., as chairman, and Henry T. Heald, president, Illinois Institute of Technology, and consisting chiefly of outstanding gas industry executives whose companies support the program.

Fred Lister, research associate, with equipment used for recording density of modified gas mixtures by the effusion method.

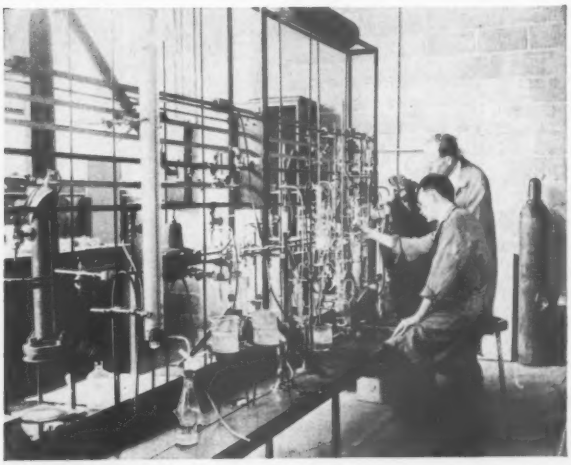
Pilot plant investigation of chemical reactions of natural gas hydrocarbons which has numerous potential applications to war program.



Dr. Charles H. Riesz taking data on separation of natural gas components with a Podbielniak Hydrobot, a high precision unit.

George J. Verbeck, research associate, examining an experimental retort for high temperature carbonization of solid fuels.

Permanent microfilm copies of original research records are made by the Institute's library, an important adjunct of its laboratories.



Organic sulfur research conducted for the Rochester Gas and Electric Corp., and the A. G. A. Organic Sulfur Subcommittee.

Dig for Victory . . . *Gas Utility Plays Leading Role in Garden Program*

H. Vinton Potter

By H. VINTON POTTER

Sales Manager, Fall River Gas Works Co., Fall River, Mass.

AND now comes Victory Gardens.—So what?

Like most utilities, we had protected ourselves with a fair reserve of merchandise so that even now we can still maintain some semblance of an attractive floor display. Many models, however, have been sold out, and our store is gradually beginning to look like a dance hall without the dancers. Some stores have allowed themselves to become completely divested of all appliances—a condition which is probably as depressing to bill-paying customers as it is to employees. Other companies have adopted the expedient of moving the cashiers to the front of the store, nearer to the door, to overcome the look of emptiness that might otherwise prevail.

Creating Good-Will

In making such decisions, we must not overlook the fact that some day we will again have merchandise to sell; and the selling we do now, or the leadership we assume in community projects, or the favorable contacts we keep up with our customers, may furnish us with an entree that will pay dividends in sales later on.

To keep our store interesting in appearance, we have been conducting regular classes in one portion formerly devoted to merchandise displays; and have brightened up the rest of the store with the usual war bond booth, food information displays, home service displays, etc.

And then came victory gardens.—So what?

Government officials recognize the seriousness of the food situation, and the demands that will be placed upon America for feeding the world. With this in mind, rationing of canned goods and other food products was inevitable, and the slogan "grow more or eat less" assumed real significance. Victory gardens are not new—having played an important part in winning World War I; and World War I was not so long ago that people have forgotten the thrill that came to them from growing their own food for those dark days before. So the victory garden movement did not take long to catch the popular fancy; and recognizing that this was first of all a problem that was ours in common with those we serve, we felt that we as a utility had a definite part to play, forgetting for the moment any selfish considerations that might accrue to us later.

Early in February, we made plans that we hoped would establish us as the leader in victory garden planting for our city, and made immediate arrangements to start things off on March 9 with two meetings in our store. We were fortunate in securing as our speaker the head of the Department of Food Preservation at the State College, who is now serving as secretary on the Governor's Victory Garden Council. We presented him first at the Kiwanis Club luncheon meeting, then at two o'clock we had an open meeting for the general public; and at three-thirty another meeting was held to which representatives of selected groups were invited. These groups included gardening clubs, settlement houses, etc., where victory garden programs were in prospect. The meetings were most

DIG FOR VICTORY

HERE ARE THE FACTS

It is hard for us to realize that actual food shortages are expected next winter. Here are the facts. Food is a weapon of war—a soldier eats twice as much as a civilian—and our fighting allies as well as the people in liberated countries must be fed. This is a big task—especially with fewer farmers to do the job. We must grow our own food or eat far less. This leaflet prepared in cooperation with the Victory Garden Committee headed by Mr. Harry M. Wood will be helpful to you.

RAISE YOUR OWN VEGETABLES

Everyone needs plenty of vegetables—at least two each day. Uncle Sam will take more than 50% of the vegetables packed commercially this year—and ration points wont provide enough for your needs. That is why we suggest you raise your own in your flower garden, lawn or nearby vacant lot.

EAT SOME—CAN SOME—STORE SOME

There's a thrill in every square foot of a home garden—and your whole family will enjoy the abundance of fresh vegetables. Eat all you can—then preserve the surplus. You don't need to can a bushel at a time—home canning is so simple you can do up just a few jars of any crop that grows faster than your family can use it.

Call at our Victory Garden Centre for free information.

FALL RIVER GAS WORKS COMPANY

CANNING POINTERS

PLAN YOUR CANNING

The folks of the Massachusetts State College Extension Service estimate that each person needs 150 pints of canned vegetables and 25 pints of canned fruit per year, in addition to that which is used fresh. Deduct the amount you can get with your ration coupons (about 48 pints per year) and you will see the need for home canning.

BUY SUPPLIES EARLY

Our government promises us all the supplies that can be made—but it is still a good idea to dig out all the old jars in your cellar—plan your canning program NOW—and shop for jars and jar rings as soon as possible.

SAVE COFFEE JARS, ETC.

New lids are available for the new quart coffee jars—and you can use mayonaise and pickle jars for much of your home canning. Save every jar—we'll show you later how to use them.

USE SIMPLE NEW METHODS—They're Easy

1—Don't bother to sterilize jars before canning—just wash them thoroughly.

2—It isn't necessary to pre-cook vegetables (except greens) and no special cookers or utensils are necessary.

3—Do not invert jars after processing.

4—Follow the Gas Company Canning Chart or any reliable canning directions.

Your Gas Company will supply you with instructions for all types of home canning, or write to Extension Service, Mass. Dept. of Agriculture, Segreganssett, Mass., for free copy of booklet "Home Canning".

FOR CANNING INFORMATION—CALL 5-7811

FALL RIVER GAS WORKS COMPANY

Front and back covers of four-page folder currently being distributed with gas bills

Victory Garden Center set up on Fall River Gas Company's sales floor. Packages of vegetable seeds shown on columns at left and right are the "big six" recommended for planting in that area

Sales floor display originally used for nutrition information center and now converted to the gardening program. The "big six" are also featured and canned goods in background suggest the eventual canning program

successful, and we had taken the lead before much thought had been given to the program by others.

By keeping in touch with the agencies which were destined to become the leaders in this project, we have been able to keep our program in tune with developments as they came about. Shortly after the City Victory Garden Committee organized, we offered our services and asked for suggestions as to ways in which we might help. The committee is building its program around the "big six"—six vegetables considered best by the State College for victory gardeners in this section to grow because of the ease with which they can be grown and the food value inherent therein. As a result of a suggestion made by the chairman of the committee, we are currently distributing an insert with our gas bills setting forth the need for victory gardens, essential information about each of the "big six"—including vitamin content, planting directions, suggested varieties for Fall River, etc., and tying in to it the urge to can as much as possible for next winter's needs.

We next offered to set up a booth in our store called the "Victory Garden Center" where authentic information could be given out to bewildered arm-chair farmers. We talked the matter over with the War Services Division of the Fall River Civilian Defense Organization whose block leaders are organized to canvass all homes in the city. The Kiwanis Club was also approached because it had manifested an early interest in victory gardens; and the 4-H Club, although not particularly strong in urban communities does have a group of interested youngsters in one of the outlying sections we serve. These three organizations agreed to furnish representatives who would man our center from two to five each afternoon and we then set about building up a library of information which would leave few questions that could not be answered by the attendant in charge. Questions which can not be readily or reliably answered at the moment are written down on a penny postcard, and before the day is over it is referred to members of an information group, and the answers filled in, and the card dropped into the mail that same night.

The group to whom these questions are referred for answers consists of the head of the Grange in this area, president of the Garden Clubs of Fall River, and a member of the City Park Department who graduated from the County Agricultural School. Due to the diligence of the workers who have manned our Victory Garden Center, all questions have been answered satisfactorily without being referred to the committee. A recent development has been the request by the city that we be the down-town point at which soil samples may be left for testing, and to each sample left with us is attached a postcard with a form to be filled in by the person who tests the soil showing the amount of lime indicated in that particular kind of soil. Soil samples are sent daily to the City Green House, and reports given by mail with a minimum of delay.

With this background of progress made in establishing ourselves as a center for authentic gardening information, we answer the question "so what?". A utility is dependent upon favorable contacts with its customers, and unfortunately restricted merchandising activities have cut our home calls and office calls down to a minimum. Many utilities are recognizing the need for increasing home service activities to keep customers looking to us for assistance. Like the housewife who must turn to us for help in working out problems caused by rationing, so victory gardeners must turn to someone for help as he selects his land, plants his seed, and fights the inevitable horde of bugs and diseases which will set in as the summer progresses. We have found our newspaper, like all newspapers, to be solidly behind the Victory Garden Program; and their eagerness for information regarding our activities is most encouraging, for in past years publicity for gas companies has been extremely hard to get.

We have been more than pleased

with the reaction of the people who have thus far manned our Victory Garden Center, and who have expressed a real satisfaction in being able to help those who have come to them with their problems. These people are business leaders and people prominent in city activities, and we feel that our contacts with them are very worthwhile. We have also found many customers who, having received the information they needed or a government bulletin which will help them, have asked the charge for the service rendered.

Of course, if we want to think of the profit that will accrue to the gas company, in addition to the good will that can be engendered now and which will prove valuable to us later on, we can point with much certainty to the inevitable gas load that will come as garden products are preserved; and even though the food situation clears up within a year or two, the effects of this year's intensive canning program will record itself in added revenue to us for many years to come.

New Helium Plant

MARKING a tremendous increase in the output of vital helium for the Navy's antisubmarine blimps and other important war uses, the Bureau of Mines recently shipped the first carload of helium from its new and largest helium plant "somewhere in Texas" and announced simultaneously that work is being rushed on four other similar plants to bring the production rate of the noninflammable gas for 1943 to about 40 times that of prewar days.

In reporting to Secretary of the Interior Harold L. Ickes on the progress of the bureau's $16,000,000 helium-expansion program, Dr. R. R. Sayers, director, said that the four additional plants, now in various stages of construction, are located "in the Southwestern area" and that by the end of this year the bureau will have a total of six plants turning out helium for war needs.

The Laclede Gas Light Company in St. Louis offers the housewife a helping hand in this impressive newspaper advertisement

Electric Bond and Share Company Reports

THE 100,000 stockholders of Electric Bond and Share Company are told in the thirty-seventh annual report made public April 14 that in spite of a bright outlook for post-war markets, regulatory action and heavy increases in federal taxes pose problems which must be solved as first steps toward a better future. In submitting the report to stockholders, C. E. Groesbeck, chairman of the board, and S. W. Murphy, president, stress the importance of close cooperation of stockholders, regulatory bodies and the company's management in the solution of these problems.

The report points out that heavy new demands for gas, particularly in the area served by the United Gas Corporation, have been met. Electric Bond & Share companies in the United States sold 300,369,000,000 cubic feet of gas, both natural and manufactured, in 1942, an increase of 7 per cent over the previous year and the highest ever attained. Additional pipe lines were built and more are contemplated.

Lost-time accidents were decreased by more than 15 per cent, it is stated. About 15 per cent of the company's employees have entered the nation's armed forces.

1942 A. G. A. Proceedings Now Available

PROCEEDINGS of the American Gas Association for 1942, containing all reports, papers and discussions presented at the twenty-fourth annual meeting of the Association in Chicago, Ill., October 5 and 6, is just off the press. Although somewhat condensed in size (441 pages) as compared with previous years, this year's volume is particularly valuable as it covers many gas industry developments since the war began.

In addition to industry-wide reports presented at the General Sessions, the 1942 Proceedings carries sections devoted to Natural Gas, Accounting, Residential, Industrial and Commercial, and Technical subjects. Cloth-bound, illustrated and indexed, it is a valuable adjunct to the gas man's library. Copies are available at $3.00 to members and $7.00 to non-members of the American Gas Association, 420 Lexington Ave., New York, N. Y.

Future of Natural Gas and Its Derivatives

By K. S. ADAMS

President, Phillips Petroleum Co.
Bartlesville, Okla.

K. S. Adams

THE future of natural gas and its numerous derivatives has become a live subject in a world filled with uncertainties, in a world where new discoveries are changing the established order of things almost overnight. Although natural gas has, in the past, been regarded almost exclusively as a superexcellent fuel for use in special heating processes, it now appears that there are a number of other important uses, as in the manufacture of chemical derivatives. Consequently, it is only normal that we should speculate on the future of natural gas, on whether there are enough reserves to furnish future markets, and on whether those future markets will be as we have known them in the past or markets of a different character.

Natural Gas Defined

Each individual has his own idea as to what natural gas is. The consumer of natural gas as fuel knows that it is that substance which enters his premises through a pipe and produces the flame in his range, oven, or furnace. The producer knows natural gas as that substance which issues in a gaseous form from geological formations beneath the earth surface either with or without oil. Yet, there is quite a difference between the various gases, and we must go to the chemist's definition of natural gas—a mixture of paraffin hydrocarbons, existing in a gaseous form—to describe the differences. Natural gas, as the producer knows it, is a complex mixture of compounds of carbon and hydrogen. It contains Methane, Ethane, Propane, Butanes, Pentanes, Hexanes, etc., which are names given to the paraffin hydrocarbons, in various proportions. In most cases, the gas which reaches the consumer has had removed from it the latter members of this hydrocarbon series and remains as a mixture of methane and ethane which amounts to some 90 to 95% of the original gas. Those extracted compounds were removed because at low temperatures and high pressures, they condense to liquids and interfere with gas transmission. For distinction, let us call the gas delivered through trunk lines or long distance pipe lines for ultimate distribution to the consumer for fuel, "High-Line Gas."

This brings us to the subject of "Derivatives." Webster says that a derivative is "a substance so related to another substance by modification or partial substitution as to be regarded as theoretically derived from it, even when not obtained from it in practice." This definition, as broad as it is, when applied to natural gas would cover practically all compounds composed of carbon and hydrogen. Therefore, let us limit our definition of derivatives of natural gas to those chemical compounds produced by using one or more of the constituents of natural gas as a raw material.

Having defined natural gas and derivatives of natural gas, and before proceeding with a discussion of each, it might be well to summarize briefly the statistics regarding gas reserves and the current rates of consumption. Natural gas, as you well know, is produced to some extent in 37 of our 48 states. The proven gas reserves in place have been conservatively estimated at eighty-five trillion cubic feet, and the potential and unproven reserves are estimated to be in the order of another eighty-five trillion cubic feet. Most of the proven reserves lie in the Gulf Coast and Mid-Continent Areas.

The consumption of natural gas in the United States in 1941 was 2.8 trillion cubic feet, and at this rate of consumption, there are apparently enough proven reserves to supply our present requirements for approximately 30 years, and enough potential reserves for another 30 years or a total of 60 years. In this connection, it is well to observe that the ratio of reserves to consumption has materially increased during the past decade. The petroleum industry is continually exploring for oil and gas, and it is believed by some that we have not begun to exhaust the possibilities of new discovery.

Volume from "Dry" Gas Fields

Gas fields from which the greater withdrawals are being made are those known as dry gas fields—those in which gas is not associated with oil or distillate, and casinghead fields—fields in which gas is produced along with oil. There are many large fields known as distillate fields in which recycling operations are being conducted to recover the heavier hydrocarbons, while the merchantable gas is being returned to the formation and held in storage for future use. It is this gas which will make up a large portion of our supply in the distant future.

Recent emphasis placed on the urgent need of natural gas for the war effort as well as non-war needs demonstrates the soundness of the current practice of closely controlling the natural gas produced in oil production operations, in such a manner that the gas may be conserved and the maximum oil production may be

Presented at Natural Gas Management Conference, Cincinnati, Ohio, April 28, 1943.

obtained. Reinjection of gas during the early stages of oil production, as in the case of the distillate fields, portends a future predictable gas production rate compatible with economical pipe line gas purchase practices; therefore, excess gas from future oil fields within striking distances of gas pipe lines will furnish a larger per cent of pipe line gas than in the past. Also recent gas repressure and storage programs in semi-depleted oil fields show that oil reservoirs may be successfully used for the storage of gas that can be advantageously used by gas pipe lines in the future.

While, in general, the oil producers have been quite successful in unitizing oil fields, cutting operating costs, and in many instances increasing ultimate recovery, there seems to be a lack of this type of operation among the gas producers in the strictly gas producing fields. The desirability of unitization of gas fields has not been sufficiently explored with its resultant greater recovery, and more stable operation.

Long Distance Pipe Lines

In the past fifteen years, we have seen several transcontinental natural gas transmission lines come into existence. These lines have brought communities in the Northern and Eastern Mississippi Valley the benefits of natural gas which the people of the West Coast, the Mid-Western Area, the Gulf Coast, and the West Appalachians have long known. At the time of our entry into the war, there were additional pipe lines being proposed. As a result of our need for natural gas in defense activities, the existing pipe lines have been taxed to the utmost of their capacity and due to the more urgent needs for steel, the proposed pipe lines have not been built. There is every reason to believe that with the resumption of peace-time activities, not only will the existing lines be enlarged, but new lines will be built, thus bringing a better form of fuel and the resultant comforts to a larger proportion of our population.

"High-Line" natural gas has for years been used as a fuel. It is used in domestic ranges, water heaters, space heating, commercial establishments and industry. It was once used for lighting, but this has almost entirely been replaced by the incandescent electric bulb. We are now coming forward with gas refrigeration and even better gas residential year round air-conditioning. To borrow the words of John K. Knighton, Servel, Inc.,—"We have every reason in the world to become excited about our possibilities, because of the peculiar suitability of the new absorption unit to residential requirements." We have all seen the insulated automatic water heater replace the older side-arm heater. There are many more developments to be expected in the future. In the past, new lines of ranges and water heaters have been attractive and serviceable, and they have had very good public acceptance. In the future, they will meet equal acceptance, thus producing an increasing base load for our sales.

Commercially, "High-Line" natural gas has been found ready and adaptable for many uses, and will continue so in the future. There has always been a fairly extended use of commercial natural gas, and today we see many new establishments, which are using natural gas for food preparation, water heating, space heating, and miscellaneous purposes. Those who have found natural gas so adaptable in keeping up with changes in meeting their war time commercial fuel problems will not turn to an inferior fuel for their peace-time needs.

Industrial Gas Acceptance

Industrially, "High-Line" natural gas is used wherever heat is needed. It has been used for various industrial processes during peace-time and is now being used for these same processes and many more in the manufacture of war materials. Natural gas is being used extensively in the fields of metal heating and heat treating. Acceptance of natural gas for these two jobs began long before the present emergency. The development of the radiant tube heating elements has opened a wide field in heat-treating operations. Natural gas is used in the fabrication of aluminum, in forging projectiles, to form glass, harden armor plate, harden cartridge cases, temper instrument mechanisms, anneal bright steel, anneal gun turrets, heat rivets, in soft metal melting, in continuous ceramic kilns for china, in the drying of foods, and in a wide variety of other heating operations.

During all of this increased demand on industry for the production of war materials, it has been learned that natural gas is not merely a fuel. The industrialist has learned that in a large majority of the industrial heat applications, natural gas is not only more economical but that due to technical utilization factors and process requirements, it also does an improved job and has become a necessary war material. Slowly and carefully, we are building up in industry a reserve of confidence in natural gas and a background of experience and development that is going to be extremely valuable in the future.

Chemical Derivatives of Natural Gas

The chemical derivatives of natural gas have also come in for their share of attention. Although the more recent chemical developments, those which probably make newspaper headlines, are regarded as something new in the oil and natural gas industries, since we hear them commonly referred to as "the new chemical developments," it should be understood that there is no definite line of demarcation between the preparation of chemical derivatives and the preparation of the more conventional gasoline and lubricant products of the refining industry. All products, whether they be classed as fuels and lubricants, or as some special drug, are still chemicals in the strict sense of the word. Hence, the oil and natural gas industries should for practical purposes, be regarded as chemical industries. One might say that we have merely broadened our field.

A number of various chemical processes for the conversion of natural gas hydrocarbons into new and useful products are already in commercial use in the petroleum refining and in other industries. Many other developments have been worked out in the research laboratories of the industry. It remains necessary for further research only to determine ways to reduce costs to the level of commercial practicability. When this has been done even more remarkable

developments will become subjects for every-day discussion.

The natural gas industry is interested in these developments, for questions frequently arise as to their possible effects on such things as depletion of reserves, changing the characteristics of gas available for transmission and distribution, establishing new raw material values for gas, opening new markets, and similar items.

Technological Developments

A few of the newer technological developments which have resulted in processes utilizing oil and natural gas as raw materials should be mentioned,—even though the ultimate possibilities of most of them will not be known for some time to come. Since there are a number of good reasons for believing that the influence of the newer chemical developments in the natural gas industry will be slight, if not definitely beneficial, we would like to give brief considerations to some of those reasons before attempting any discussion of the new developments.

As we stated at the beginning, "High-Line Gas" is largely composed of methane, and methane is the most refractory of hydrocarbons. By the term refractory we mean lack of susceptibility to conversion to other products. Methane is the most difficult hydrocarbon to break up into its components or other compounds. The chemical reactions applicable to methane are few in number and the outlets for the possible products of such reactions are still relatively limited when compared to the enormous supply of methane.

New developments of "high octane gasoline from natural gas," synthetic rubber, organic chemicals, solvents, explosives, etc., are largely built around those gas ingredients that are removed in processing gas for high pressure transmission. These latter raw materials, the hydrocarbons (propane, butane, pentane, etc.) are fractions of gas which have hitherto largely been consumed in low value utilization. Refinery gases are also an important source of hydrocarbons of this type. It should be kept in mind, however, that the amount of such materials present in natural gas of "high line" quality is negligible and their removal in general will tend toward uniformity and improved performance in appliances.

This leads us, naturally, to the question of total raw material requirements. For example, what sort of raw material volumes are we speaking of when we look to the chemical activities as an outlet for gas even disregarding for the moment matters of gas composition, etc.? The best answer is that they are small,—much smaller than the almost astronomical volume figures for fuels with which the gas industry is familiar. This is even true for those constituents other than methane. It has been estimated, for example, that the total potential markets, not restricted to "high-line gas" hydrocarbons, which we can currently anticipate for hydrocarbon raw materials in the chemical industry would not be much more than twice the present marketed volume of liquefied petroleum gases. That might sound like a large volume, some 1,000,000,000 gallons annually; and yet that volume is considerably less than ten per cent of the total ethane, propane, and butane currently estimated as being annually available.

Chemical Markets

The limited size of the chemical markets compared to the usual outlets for petroleum are still more strikingly apparent from one or two specific examples. Thus, the pre-war annual production of methanol, wood alcohol (both synthetic and from wood distillation), some 20,000,000 gallons, could have been produced from a single gas well of 10,000,000 cubic feet daily capacity if near perfect conversion efficiencies are assumed. The potential production of just one of our smaller gas wells would thus flood the market. Somewhat less than 1,000,000 cubic feet of natural gas per day would theoretically furnish all of the carbon tetrachloride sold. We have chosen these examples because they are among the

Here's What Your War Bonds Buy

When a seven-day war bond campaign among more than 700 Portland Gas & Coke Company employees raised payroll purchases above the 10 per cent goal, the committee celebrated by visiting Portland's air base to see what the year's pledges of $128,000 would buy. They were shown one of the speedy new Lockheed-Vega Ventura bombers which aren't helping Hitler's headache the least bit. The campaign made the company's employees eligible for the Treasury Department's Minute Man flag with the coveted "T"

Nutrition Circus Is Smash Hit

Mary Pat Geary, of the Minneapolis Gas Light Company's home service department, with her nutrition circus in the display case

This unique nutrition circus in Minneapolis attracted more attention than any other display ever set up by the home service department. The animals were made of vegetables and fruits, with corresponding slogans

important chemicals from a volume standpoint.

Similar comparisons could be drawn for other chemicals. Thus, if all of the ethane annually available were quantitatively converted to ethanol, ethyl or grain alcohol, the astounding volume of 100,000,000 barrels of ethyl alcohol would be the result. If ever we were to encounter such a thing as an alcohol famine, we might turn to the propane and butane available for another 200,000,000 barrels. The only thing we haven't been able to figure out is what to do with that final volume of 300,000,000 barrels. Another example is the much discussed synthetic rubber. The volume of butadiene for Buna rubber which could be made from the butane annually available would result in a volume of rubber approximately five times that consumed in normal times. Is it any wonder then, that the petroleum industry looks forward with confidence to the nation's current rubber problem? Raw materials are present in abundance.

The sum and substance of this situation is that outlets for natural gas hydrocarbons in the strictly chemical industry are quite meager even if we include all the gas hydrocarbons.

Having demonstrated the probable effects on the gas industry of the manufacture of derivatives we will review briefly a few of the more outstanding developments in the field on converting natural gas hydrocarbons, or more properly, light petroleum hydrocarbons, into new products. In each instance, of course, it should be kept in mind that there are other routes to the ultimate products and these routes may involve the use of raw materials other than natural gas hydrocarbons. The chemist has turned to natural gas hydrocarbons only because they are ample and readily available. The same ultimate result might have been and might yet be attained in each instance by starting with coal, our other abundant supply of organic raw material.

New developments may be considered, as falling into two major classes, (1) those concerned with the conversion of hydrocarbons into liquid fuels of superior characteristics to natural or cracked liquid fuels and (2) those concerned with conversion to other products. The volume of raw materials involved in commercial operations under the first of these classes is many times that involved in commercial operations under the second. It is for that reason that we discuss them in that order.

The hydrocarbons we mentioned earlier, namely, ethane, propane and butanes, which are currently being used as raw materials in processes for the production of liquid fuels, occur in appreciable percentages in natural gases before processing for transmission and are also present in residual gases from refineries as by-products of oil cracking. In the latter case, the subject hydrocarbons are, of course, associated with the corresponding olefin (unsaturated) hydrocarbons which have long been known as particularly desirable materials for chemical synthesis of various sorts.

Conversion to Liquid Fuels

The processes by which natural gases and the still more complex offgases of refineries are converted to liquid fuels are extremely complex since all of them involve one or more of the chemical reactions known as pyrolysis (decomposition by the action of heat), dehydrogenation (splitting off hydrogen), polymerization (recombination of hydrocarbons deficient in hydrogen), hydrogenation (addition of hydrogen), alkylation (combination of unsaturated hydrocarbons with saturated hydrocarbons), and in some cases, isomerization (internal rearrangement of molecular structures).

The earliest of these developments, low pressure pyrolysis (thermal cracking) taught us that benzene, toluene, xylenes, and heavier aromatic products, formerly derived only from coal carbonization, could be produced from natural gas. This extremely versatile process not only can be made to produce the aromatics, but also the valuable oelfin (unsaturated) hydrocarbons, which have so many uses in organic chemical synthesis. One of the olefins (ethlyene) produced in this process is used in producing tetra-ethyl-lead, neohexane, much of the industrial alcohol, and ethyl benzene, which is ultimately converted to the rubber and resin raw material known as styrene. The higher olefins, similarly produced, are raw materials for aviation gasoline and butadiene, the other important rubber material.

Next, high pressure pyrolysis of natural gases gave the industry its

first practical process for producing premium motor fuels from gases which were largely wasted prior to such development. It has been estimated that prior to the war, thirty per cent of the available butane was being used annually in this process as a raw material to produce approximately 15,000,000 barrels of high quality motor fuel.

Dehydrogenation, polymerization, and hydrogenation brought forth the production of isooctane and other high octane motor fuels.

An astounding discovery along this line was announced a number of years ago, namely, that the proverbially inert hydrocarbons could be made to react with olefins to produce a saturated product. Fuels having octane numbers greatly in excess of

(Continued on page 231)

Gas Stoves Take Wing

By H. H. GRANGER

Secretary, Hardwick Stove Company, Cleveland, Tenn.

IN the heart of the South at Cleveland, Tenn., is located the Hardwick Stove Company, which has been in continuous operation since 1879.

In late 1941 a visitor being shown through Hardwick's numerous plants would have seen a modern stove foundry in operation; steel fabricating departments equipped with the latest style presses, busily at work; a complete woodworking unit turning lumber into crates; a modern enameling plant for coating steel and iron stove parts with vitreous enamel; numerous assembly lines upon which a great variety of gas ranges, cooking stoves and heaters were being assembled and given the final inspection before shipment.

The scene changes. The time is 1943: A visitor to the company's plant today would be astounded at the visible transformation. Not a stove or range is in sight. Gone are the familiar scenes of stove moulders and mounters at work. Instead, department after department and floor after floor find busy war workers concentrating on the production of aircraft parts and sub-assemblies. Men and women working side by side in each shift applying their energy and skills with patriotic zeal to meet accelerating production schedules. The entire plant and personnel has literally taken wing and Hardwick's war products are now flying over numerous foreign lands as a part of Uncle Sam's Air Fighting equipment.

The same mass production methods so successfully used in making stoves are being employed to advantage in producing aircraft wing sections and fuel tanks for assembly by the airplane manufacturer into the finished planes.

Chromic acid dip and cleaner tanks heated with gas

Gas Heat Treating

Heat treating of aluminum alloys is an essential process in aircraft production. The main function is to increase its tensile strength in order to stand the stresses and strains to which the materials are subjected in combat service.

The requirements for heat-treating equipment are primarily uniformity and accuracy of temperature. It involves bringing the material to a prescribed temperature, holding it there for a prescribed length of time and then promptly quenching it in cold water.

A seven-foot steel tank with fire brick walls was constructed to hold a solution of potassium and sodium nitrate salts which is heated with gas to an average of 920° F. Two long gas burners, each having seven jets are used and an average of 1,000 cubic feet of gas per hour is consumed. The efficiency of gas as a heating medium is demonstrated by the uniformity of temperature which is maintained constantly within 5° of the desired heat.

Four twelve-foot tanks are used for the chromic acid dip and rinsing, each equipped with nine gas burners. Hardwick also uses gas for the heat treatment of tool steel and dies for hardening purposes. A gas oven of suitable dimensions for various sizes of these metals is utilized and is in constant operation in the machine shop.

After parts are formed, heat-treated, cleaned and painted, they go to stock rooms adjacent to the assembly floors, ready for assembly as needed.

In any successful manufacturing business there is no substitute for skilled craftsmanship, engineering ability and capable, versatile management. In the production of aircraft sub-assemblies now being turned out by the company, the requirements for precise workmanship, and ability to work with tolerances unheard of even in the best of managed stove factories, has developed an exactness and accuracy in skill that will be reflected in better stoves and ranges after the war.

Working with tolerances of 3/1000 of an inch is not unusual and, in most instances, is required in order that all sub-assemblies fit or mesh perfectly with all matching parts in the final assembly of the plane by the aircraft manufacturer. In addition to the perfection in workmanship acquired by the workers and foremen, the contacts of the management, engineering and designing staffs with specialized manufacturing processes and scientific developments in the use of new materials presages many new developments in gas range construction for the future.

The war's end will find this organization with an impressive record of accomplishment in the part they are taking now to keep American airmen flying and it will find a trained personnel ready to turn their experience and abilities once again toward producing stoves and ranges for the postwar period.

Formerly a modern gas stove foundry, these two scenes depict the wartime transition. Above is the oil tank assembly room while at right workers are shown producing aircraft wing sections. Note predominance of women employees working on the wings

More Gas Than Ever Used in War Plant

By F. J. NUNLIST

Asst. Chief Engineer, L. J. Mueller Furnace Co., Milwaukee, Wis.

IT would be difficult to find anywhere a more forcible demonstration of the versatility and practicability of gas as an industrial fuel during wartime than in the plant of L. J. Mueller Furnace Company, Milwaukee, Wisconsin. Always a fairly large consumer of gas for industrial purposes the conversion of this plant from the manufacture of gas-fired equipment to war production has increased this normal demand and consumption greatly within the last twelve months. Today, almost 5,000,000 cubic feet of manufactured gas are used each month in heat-treating, core-baking, paint-drying and japanning, degreasing and testing of finished products.

When this company determined early in 1942 to convert its plant to war production, intimate knowledge of the problems of application and installation of industrial gas equipment carried much weight in obtaining large scale prime contracts for ordnance materiel.

In the heating-treating department alone more than 3¼ million cubic feet of gas are used each month. Of this quantity, approximately 1¼ million cubic feet are burned to provide a protective and neutral atmosphere in the brazing furnaces which produce a large quantity of material every month, with an almost negligible quantity of scrap.

The balance of the gas is burned in salt bath pot-type hardening furnaces, several different types of draw or tempering furnaces, special degreasing units, and the like.

An additional 350,000 cubic feet of gas are burned in a degreaser of Mueller's own design and construction, which thoroughly cleans and washes all parts before assembly, so as to insure perfect brazing results in the finished product.

Without the close temperature control which gas as a fuel permits, and without fully automatic control of this temperature, the total quantity of finished product would of necessity be much smaller, and the number of the men required to produce it much greater. We can truthfully say that the choice of gas as a fuel has been a fortunate and an economic one.

Early in 1940, 3 large core-baking

Two continuous roller hearth hydrogen brazing, hardening and quenching furnaces. Consumption of gas as a protective atmosphere on these units amounts to over 1,250,000 cu.ft. each month

Salt bath heat-treating department showing gas-fired salt pot-hardening furnaces, oil immersion quench tanks and in the background two degreasing and rinsing tanks heated by gas-fired boilers. Two recirculating type gas-fired tempering furnaces can also be seen in the background

Three gas-fired box type recirculating draw furnaces

Above left—Closeup of two gas-fired high velocity recirculating tempering furnaces

Drawer type gas-fired core oven with an approximate consumption of 125,000 cubic feet of gas per month

ovens were constructed and placed in operation to replace our previous coke-fired equipment. The demand of increasing quantity and improved quality of castings, necessitated this "Modernization with Gas." Today, we are burning about 650,000 cubic feet of manufactured gas per month in these automatically controlled core ovens in our foundry.

An additional half million cubic feet of gas per month are used in our paint-baking and japanning ovens, miscellaneous soldering, brazing and tool heat-treating throughout our plant, and in production and developmental inspection and testing work.

The value of all of these applications is unquestioned and significantly demonstrates the well-known slogan of industrial and commercial gas men "The Trend Today Is to Gas."

Voluntary Fuel-Saving Campaign Works

THE voluntary Fuel Saving Campaign in England has been sufficiently successful to defer fuel rationing, Mrs. Eileen Murphy, home service director, The British Commercial Gas Association, states in a letter to Davis M. DeBard dated February 23, 1943. Reports reaching the Ministry of Fuel and Power about the state of the fuel campaign suggest that the public, both in their homes and their places of work is making a real effort to achieve the necessary economies.

Although it cannot be said yet that the emergency period is over, the favorable progress of the campaign to date is reassuring, Mrs. Murphy says. One large gas undertaking in the North of England, for example, has reported a saving of about 12% in domestic consumption; in the South during the December quarter ordinary gas consumers effected a like reduction.

As regards the country generally, Mrs. Murphy reports, statistics showing the coal consumption by gas and electricity undertakings during the past two years prove that, whereas consumption rose between April 1941 and April 1942, it showed a significant decline since the latter month. For example, the percentage increase in consumption in December 1941 was 11.7 for gas and 13.6 for electricity; in December 1942 it was 2.2 and 1.6 respectively. Since industry has not yet reached its peak demand for either fuel, the percentage increase would have been very much higher had no economies been adopted.

Mrs. Murphy points out that "the national need for fuel economy is having one good effect: it is directing public attention more and more to our use of fuel, and to the waste that goes on in ordinary times through the uneconomic application of fuels to domestic needs. The gas industry has nothing to fear from such an examination. The valuable raw materials extracted from coal in the process of gas-making are in themselves a justification of the carbonizing process, while the gas industry in returning for the nation's use half a ton of coke from every ton of coal used is making a very worthwhile contribution towards fuel economy, and the larger problem of coal conservation which should be studied in connection with it."

Natural Gas Well Pure Nitrogen

BELIEVED to be the first pure nitrogen natural gas well ever discovered in the United States, a producer has been brought in at a shallow depth in eastern Wyoming, according to Harold J. Cook, consulting geologist, at Agate, Neb.

In the course of drilling a water well on the W. H. Cross ranch near the southern rim of the Powder River Basin the bit penetrated a sand containing a non-inflammable gas, under considerable pressure, at a depth of only 156 feet. The well was shut down for a check and testing.

The well created so much interest that Warren D. Skelton, Wyoming state mineral supervisor, took a sample of the gas and submitted it to the U. S. Geological Survey testing laboratory in Casper, Wyoming. J. G. Crawford, chemist for the Geological Survey, made the test and found that it was 100% pure nitrogen gas.

The well has been shut down and closed, but because of the possible use of this remarkable well for war purposes, the field may have potentialities.—*The Flow Line.*

Houston Natural Releases Blueprint of Dealer Cooperation for 1943

Frank C. Smith

A BLUEPRINT of Dealer Cooperation for 1943" is the title of the portfolio recently placed in the hands of all cooperating gas appliance dealers in the Houston Natural Gas System.

Portfolios are not new to the company's dealer-cooperation program, for they have been utilized for many years as an important cog in the annual sales presentation and for special promotional activities. This year's portfolio is unique, however, in that it is designed to serve in lieu of the 1943 sales meetings.

The following letter from Frank C. Smith, president of the Houston Natural Gas System, to cooperating dealers and friends prefaces the portfolio:

"During recent years, it has been the privilege of our company at this season to play host to gas appliance dealers and other friends who have been responsible for the effectiveness of our dealer-cooperation sales program.

"We have welcomed this annual sales meeting as an opportunity to greet each of you personally . . . . to report on progress resulting from our combined efforts of the previous year . . . . to plan with you for the future.

"This year, in deference to the war effort, we have not scheduled our sales meetings. We shall miss keenly the close association thus afforded, and hope that you will share a kindred feeling.

"We particularly want you to know, however, that even though we cannot be with you in person, we shall be with you in spirit . . . . today, tomorrow, and every day until business is once again unhampered by war.

"When Victory comes, opportunities in the merchandising of gas household appliances promise to be far greater than ever before. We eagerly anticipate this post-war period when we shall be working aggressively shoulder to shoulder with you in making the most of those opportunities for our mutual profit."

From the dealer standpoint the portfolio achieves its greatest importance in the section entitled "How About 1943?" In this section there are 11 pages devoted exclusively to the availability of appliances and the steps necessary for their procurement. Regulations governing the production and sale of gas ranges, refrigerators, water heaters and heating equipment are discussed and interpreted with reference to each specific appliance.

Pages relating to the 1943 program of national and local advertising, special promotional activities, customer-contact, dealer-contact, and the war effort are included among the other features.

As in the past, a review of the previous year's sales activities is made. It is noteworthy that the review reveals that dealers made a very creditable showing in 1942 when they sold 6,611 gas appliances despite merchandising shortages and restrictions.

In conclusion it is stated that the principal function of the portfolio has been to emphasize that the gas company-dealer relationship will be stronger than ever in the months and years to come—and to remind its readers that "Our No. 1 Job in '43 Is To Help Win the War."—*Burner Tips*

Homemaking "Trouble Shooters"

In large-scale newspaper advertisements and window displays such as this one, the Cincinnati Gas & Electric Co., Cincinnati, Ohio, is calling attention to the vital work of utility home service departments. Pointing out that "a peace-time convenience of your Gas & Electric Co. now becomes a valuable war-time information center," the copy invites homemakers to pick up the telephone and secure the help of a trained home economist. Practical cooking helps are included in the newspaper ads

Herbert B. Maynard Dies at 84

HERBERT B. MAYNARD, assistant secretary of the Iowa Public Service Company, Waterloo, Iowa, and one of the old-timers in the gas industry, died March 23. He was 84 years old and had been connected with the Waterloo company since 1906.

Educated at St. Johnsbury Academy, in Vermont, and Dartmouth and Amherst Colleges, Mr. Maynard spent 14 years in the southern states as railroad construction and maintenance engineer before entering the utility business as head of the Ottumwa Gas, Light, Heat & Power Company. Before going to Waterloo, he was manager of the South Shore Gas Co., Hammond, Ind., and, briefly, of a gas company in Elkhart, Ind. He went to Waterloo when the Citizens' Gas & Electric Co. there was bought by the four Dawes brothers—Rufus, Beaman, Henry and Charles—and I. C. Elston.

In 1917-1918, Mr. Maynard was vice-president of the Dubuque Traction and Electric Co. and divided his time between Waterloo and Dubuque. In 1923, he was president of the Iowa District Gas Association, now the Mid-West Gas Association.

He was prominently identified with club, lodge and welfare activities. While working as an engineer at Ocean Springs, Miss., Mr. Maynard had become a friend of Jefferson Davis, former president of the Confederacy.

Robert A. Carter, Jr., Is Dead

Robert A. Carter, Jr.

ROBERT A. CARTER, JR., manager of gas production, Consolidated Edison Company of New York, Inc., who was on sick leave from the company, died of a stroke April 2 near Tucson, Ariz., while enroute to New York. Mr. Carter, who represented the third generation of his family in the service of the Consolidated Edison System, would have completed forty-one years of service with the system this Fall. His grandfather, Samuel Carter, was the treasurer of the New York Gas Light Company and first treasurer of the former Consolidated Gas Company. His father, the late Robert A. Carter, Sr., was vice-president of the Consolidated Gas Company.

Born in Brooklyn, N. Y., August 9, 1884, Mr. Carter was educated in the Brooklyn public schools and later attended Pratt Institute, Euclid School and Columbia University. He started with the Consolidated Gas Company in 1902, working for two years as a stove repairman in the Customer Service Shop. In 1922 he was made engineer of manufacture for the Consolidated Gas Company and the Astoria Light, Heat and Power Company. He was appointed a vice-president of the Astoria company in 1928, and, following the merger of the Consolidated Gas Company and Astoria Light, Heat and Power Company into Consolidated Edison Company of New York, Inc., in 1936, he was made engineer and later manager of gas production.

He was a member of the American Institute of Electrical Engineers, American Gas Association, American Society of Mechanical Engineers, Illuminating Engineering Society, Society of Gas Engineering and the Society of Gas Lighting. He is the author of a number of technical papers.

Company Report Goes to Armed Forces

FORMER employees of the Wisconsin Public Service Corporation now on duty with Uncle Sam's forces in foreign lands will not be deprived of their usual copy of their employer's "Annual Report." At least extra assurance that their copies will reach them has been gained by printing a limited edition on Bible paper, the total weight with suitable envelope staying well within the recommended 2 oz. limit. Except for the paper used, the edition is identical with the regular heavy paper copies.

ADDITIONS TO THE A.G.A. FAMILY

FOLLOWING is a list of new members who have joined the American Gas Association since the beginning of the current fiscal year, October 1, 1942:

GAS COMPANIES

	Delegates
Canadian Western Nat. Gas, L't, Heat & Power Co., Ltd., Calgary, Alberta	E. W. Bowness
Central Wisconsin Gas Company, Sparta, Wisconsin	R. L. Sieben
Missouri Gas & Electric Service Company, Lexington, Missouri	A. G. Beisenherz
The Newark Consumers Gas Company, Newark, Ohio	H. H. Ross
Virginia Gas Distribution Corporation, Staunton, Virginia	J. V. Wise

SERVICE COMPANY

NEGEA Service Corporation, Cambridge, Mass.	Hall M. Henry

MANUFACTURER COMPANY

Precision Scientific Company, Chicago, Ill.	A. I. Newman

INDIVIDUAL MEMBERS

Howard D. Amann	The Brooklyn Union Gas Company, Brooklyn, N. Y.
James S. Barcus	Greeley Gas & Fuel Company, Chicago, Ill.
Samuel F. Barnhart	The Philadelphia Gas Works Company, Philadelphia, Pa.
A. R. Bayer	The Brooklyn Union Gas Company, Brooklyn, N. Y.
J. A. Benson	General Gas Light Company, New York, N. Y.
J. L. C. Black	Anderson Gas Company, Anderson, S. C.
Jeannette Campbell	Minneapolis Gas Light Company, Minneapolis, Minn.
George M. Carnes	New Orleans Public Service Inc., New Orleans, La.
Lewis M. Clarkson	Larchmont, New York
Russell H. Coe	Pipe Line Service Corporation, Glenwillard, Pa.
Chas. R. Conn	The Coleman Lamp & Stove Company, Wichita, Kan.
F. H. Crissman	Columbia Engineering Corporation, New York, N. Y.
J. C. Donnell, II	Mountain Fuel Supply Company, Findlay, Ohio
John Dopp	Wisconsin Power & Light Company, Fond du Lac, Wis.
Rulison Evans	Scranton-Spring Brook Water Service Company, Wilkes-Barre, Pa.
Bert P. Fisher	Payne Furnace & Supply Company Inc., Houston, Tex.
Walter S. Frick	The East Ohio Gas Company, Cleveland, Ohio
William H. Ganley	Falley Petroleum Company, Chicago, Ill.
Edward J. Gerridge	The Brooklyn Union Gas Company, Brooklyn, N. Y.
R. H. Groebe	The Barrett Div., Allied Chemical & Dye Corp., New York, N. Y.
C. T. Harmon	Equitable Gas Company, Pittsburgh, Pa.
Henry S. Harris	Union Light Heat & Power Company, Covington, Kentucky
Edward C. Hemes	Milwaukee Gas Light Company, Milwaukee, Wis.
G. B. Herr	The Peoples Natural Gas Company, Pittsburgh, Pa.
Henry M. Heyn	Surface Combustion Div. of General Properties Inc., Toledo, O.
Hugh H. Hite	Minneapolis Gas Light Company, Minneapolis, Minn.
Fred B. Hofft	The United Gas Improvement Company, Philadelphia, Pa.
Murry Kaplan	Kaplan Bros. Restaurant Range Division, New York, N. Y.
Elizabeth C. Keegstra	Michigan Consolidated Gas Company, Muskegon, Mich.
Robert L. Lagerquist	The Connecticut Light & Power Company, Waterbury, Conn.
Cecil G. Langford	George Glover & Company Ltd., London, England
M. H. Laundon, Jr.	The Bryant Heater Company, New York, N. Y.
William D. Levie	Koppers Company, Minnesota Division, St. Paul, Minn.
L. J. Longworth	Buzzards Bay Gas Company, Hyannis, Mass.
Wm. P. McArdle	Ebasco Services Incorporated, New York, N. Y.
Louis L. McTague	The United Gas Improvement Company, Philadelphia, Pa.
Frank Mills	Loomis-Sayles & Company, Boston, Mass.
Clement W. Moody	Cambridge Gas Light Company, Cambridge, Mass.
J. W. Monk	City of Dallas, Dallas, Tex.
James T. Morgan	The East Ohio Gas Company, Dennison, O.
Joe A. Mulcare	New York, N. Y.
A. D. Olds	The Coleman Lamp & Stove Company, Wichita, Kan.
C. W. C. Page	Koppers United Company, Granite City, Ill.
Lewis G. Paulding	Long Island Lighting Company, Mineola, Long Island, N. Y.
James A. Peirce	Industrial Oil & Gas Service Inc., New York, N. Y.
R. E. Pierce	Northern Berkshire Gas Company, North Adams, Mass.
Jerome M. Pickford	Northern Indiana Public Service Company, Hammond, Ind.
Louis Rosendhal	New York, N. Y.
Edward R. Sharp	Department of Public Utilities, Richmond, Va.

Use of Gas Showrooms in England

(Mrs. Eileen Murphy, home service director, The British Commercial Gas Association, in a letter to Davis M. DeBard.)

I DON'T think you will have any great difficulty in using your display floors when appliances have been cleared away. We thought we would have a similar problem here, but the gas showrooms are so much a part of each town's life, that they are regarded almost as civic centres. The various Government departments, the womens' clubs and societies, etc. turn naturally to the gas company when they want premises for meetings, displays, exhibitions, etc. The great thing is that the public should *continue* to *visit* our showrooms, and we have made it a definite policy over here to tie in with every local campaign. Gas can usually be fitted into the picture somewhere.

For instance gas showrooms are even used as blood transfusion centers, and are found to be most convenient, owing to the fact that methods of sterilization and refrigeration are on the spot, as well as the necessary warmth for the donors, which makes the showrooms eminently suitable for this purpose.

Transfusions have recently been carried out at premises of the Gas Light & Coke Co. at the request of the Ministry of Health and Medical Research Council. For a fortnight previously, the showroom windows were used for a blood transfusion display, and passers-by were invited to come in and have a blood test taken. 600 people accepted the offer, the tests, made by pricking the lobe of the ear, being carried out in the window in view of the public. The actual transfusions took place in a screened-off portion at the back of the showrooms, some 640 transfusions being done in a week.

American Standards

THE March issue of *Industrial Standardization,* official publication of the American Standards Association, 29 W. 39th St., New York City, contains much material of interest to the gas industry. Keyed to war requirements, feature articles describe development of current war models of various types of equipment as well as revised standards for safety and other devices. Of direct interest is an article on "New Baking Tests, Less Heat Loss for Gas Ranges," by R. M. Conner, director, American Gas Association Testing Laboratories, which describes the A. G. A. standardization program.

Among four new members of the American Standards Association whose photographs and business careers are included is that of Robert G. Griswold, president of Electric Advisers, Inc., and a prominent member of the American Gas Association.

Standard tests and specifications set up in orders of the War Production Board and the Office of Price Administration are listed in this valuable publication.

Recent advertisement in "Clean Your Plate" campaign being promoted as a patriotic service by the Minneapolis Gas Light Company in newspaper, display and bill stuffer copy

Koppers Move

TRANSFER of the New England District offices of the Koppers Company, Tar and Chemical Division, from Providence, R. I., to the Boston Consolidated Gas Building, Boston, Mass., was announced recently by J. N. Forker, vice-president of Koppers Company and general manager of the Tar and Chemical Division.

Maurice D. Gill, vice-president of Koppers Company, will remain manager of the New England district. Local offices will continue to be maintained at Koppers plants at Everett, Mass., East Providence, R. I., New Haven, Conn., and Portland, Me.

The Tar and Chemical Division engages in the sale of roofing and road tars, wood preserving oils, waterproofing materials, bituminous paints, tar acids, light oil distillates, agricultural insecticides and other related chemical products.

WPB Restricts Use of Coal Tar

UNDER conservation order M-297 dated March 29, 1943 effective May 1, 1943, the War Production Board restricted the delivery and use of coal tar defined as tar produced by the distillation of bituminous coal or lignite and including crude and refined coal tar. The use of coal tar oil defined as a distillate of coal tar, is also covered by the order which provides that on and after the effective date of the order, May 1, 1943, producers and distillers may not burn as fuel or otherwise utilize coal tar except for the purposes of distillation, and that no producer and distiller shall deliver coal tar to a person other than another distiller except upon specific authorization of WPB or as otherwise provided in the order.

No Indiana Convention

THE board of directors of the Indiana Gas Association at a meeting March 26 voted to hold no convention of the association in 1943. Instead, the annual meeting this year will be an "open" directors' meeting at the Claypool Hotel in Indianapolis on May 13.

General members of the Indiana association are invited to attend this meeting at which normal business to come before an annual meeting will be transacted and the balance of the day will be devoted to a roundtable discussion of current problems. There will be no outside speakers and no entertainment.

Joins Chemical Co.

RALPH D. WILLIAMS, for the past 17 years with Hudson Valley Fuel Corporation, a subsidiary of Niagara Hudson Power Corporation at Troy, N. Y., has resigned as plant superintendent to become technical consultant with the General Chemical Company, 40 Rector St., New York, N. Y.

For several years, Mr. Williams has been a member of the Gas Production Committee of the American Gas Association, serving as chairman of the Carbonization and Coke Subcommittee in 1941-1942.

Domestic Controls Sets Up New Office

THE Domestic Manufacturing Co., Inc., 8775 Mettler St., Los Angeles, Calif., manufacturers of thermostatic devices for domestic gas appliances, now engaged in 90 per cent war work has announced a separation of its activities. A separate office has been set up for the Domestic Thermostat Co., temporary address 440 Seaton St., Los Angeles, to manufacture and sell the Domestic line of controls. The Domestic Manufacturing Co., Inc., will continue to manufacture hydraulic valves and other aircraft components at the above address.

Wisconsin Utilities Group Names Officers

THE General Nominating Committee of the Wisconsin Utilities Association has selected the following nominees for officers of the Association for the fiscal year beginning May 1:

For president—John G. Felton, district manager, Northern States Power Co., La Crosse.

For vice-president—S. B. Sherman, vice-president and general manager, Wisconsin Gas & Electric Co., Racine.

For treasurer—D. W. Faber, secretary and assistant treasurer, Wisconsin Public Service Corp., Milwaukee.

Balloting by mail was in progress during April.

Personal AND OTHERWISE

New Orleans Gas Men Get New Posts

Jeffrey H. Collins

APPOINTMENT of Clayton L. Nairne, general superintendent of the gas department, as assistant to the vice-president in charge of operations for New Orleans Public Service Inc., has been announced by Harold E. Meade, vice-president of the company.

Succeeding Mr. Nairne as general superintendent of the gas department is Jeffrey H. Collins, who has been superintendent of the distribution division of the gas department for the past three years. Mr. Collins, who will soon have an anniversary of twenty years' continuous service with the company, has served as chemist and assistant superintendent of gas production and as assistant and superintendent of the meter and appliances division before becoming superintendent of the distribution division.

Mr. Collins is a native of New Orleans, having received his primary education here before graduation from Tulane University. He has served on numerous committees of the American Gas Association, and was named chairman of the Committee on Meters and Metering in 1942.

Mr. Nairne becomes assistant to the vice-president after fifteen years employment with the company, occupying several different positions in both the electric and gas departments.

Mr. Nairne was educated in New Orleans at Rugby Academy and received his Bachelor of Engineering Degree from Tulane University in 1924. He has been active in the Association of Commerce, Board of Trade, Louisiana Engineering Society, as well as many other civic and trade associations.

C. L. Nairne

Panhandle Eastern Makes Executive Changes

MAJOR changes in the executive set-up of the Panhandle Eastern Pipe Line Company were made April 5 at a special meeting of the company's board of directors. William G. Maguire was elected to the newly created post of chairman of the board and chief executive officer, and Edward Buddrus was elected president in charge of all operations.

Mr. Maguire is president of the Missouri-Kansas Pipe Line Company, while Mr. Buddrus, who has been in charge, as executive manager, of the natural gas and natural gasoline division of the Phillips Petroleum Company, relinquishes that post to assume his new duties. Mr. Buddrus succeeds J. D. Creveling as president of Panhandle Eastern. In addition, Hy Byrd, formerly vice-president of Phillips, was elected vice-president and treasurer of the pipe line company.

A new board of directors was elected as a result of the recent change in ownership of the Panhandle concern, under which the holdings of the Columbia Oil and Gasoline Corporation in Panhandle were sold jointly to Phillips Petroleum and Missouri-Kansas Pipe Line.

The new board of directors consists of K. S. Adams, Mr. Buddrus, J. E. Bierwirth, R. J. Bulkley, Don Emery, H. E. Howard, Ira L. Letts, F. J. Lewis and Mr. Maguire. Mr. Adams and Mr. Emery, president and vice-president of Phillips, will represent that organization on the board.

Under a contract just completed between Phillips and Panhandle Eastern the natural gas reserves of Phillips in the Hugoton gas field will be made available to the Panhandle Line.

H. H. Himsworth, who retired April 1, looks significantly at his alarm clock

Veterans of New York Gas Service Retire

VETERAN gas men with long and distinguished service records were among the group of gas and electric utility employees of the Consolidated Edison Co. of New York, Inc., who retired April 1. Those who retired from active duty are:

Hines H. Himsworth, assistant manager, gas production department, who has devoted all 35 of his years of service to gas production work. A native of England, he came to this country as a small boy and received his education at Denver University and the University of Colorado where he studied mechanical engineering. He started with Consolidated in 1908 as superintendent's assistant. When the Hunts Point plant was built in 1926, he went there as general operating superintendent, becoming general superintendent in 1932. In Sept. of last year he became assistant manager of gas production.

Thaddeus S. Barlow, superintendent, Astoria plant, who had worked for Consolidated Edison and its predecessor companies for 45 years. He started in 1897 as a clerk. In 1935, he went to Astoria as superintendent of water gas and later became superintendent of the Astoria plant.

Nathaniel J. Sperling, general superintendent, Astoria plant, who retired with a service record of 38 years.

John Andrejchak, foreman and gas holder engineer, substation operations, gas holder division, who had served the company for 44 years.

John J. Bielen, mechanic, gas holder operations, who had spent his entire business career of 41 years at the 15th Street Station of the company.

W. J. MacDaniels, commercial manager, who had completed 41 years of service.

Pictures Mixed

John A. Clark

IN the last issue of the A. G. A. MONTHLY, accompanying a story on the 45-year service record of John A. Clark, vice-president in charge of gas operations, Public Service Electric & Gas Co., Newark, N. J., there appeared a picture of John A. Clark, chief engineer, Hope Natural Gas Co., Clarksburg, W. Va. Mr. Clark of Public Service is shown herewith and the MONTHLY apologizes for the resulting confusion. We'd like to blame it on the gremlins but, as they only operate in the air, we accept full responsibility.

Incidently, Mr. Clark of Hope Natural is a nephew of his namesake, so it's all in the family—and the gas industry is proud to claim both of them.

Leon Jones, Oil Gas Pioneer, Dies

THE death of Leon B. Jones in England on January 30 came as a shock to the gas industry. Mr. Jones and his father before him were apostles of oil gas. How soundly and well they did their work was evidenced by the almost universal use of the oil gas process on the Pacific Coast prior to the discovery of natural gas.

Mr. Jones' father, Edward C. Jones, was the founder of the Pacific Coast Gas Association and for many years was its recognized leader. Leon followed in his father's footsteps, adding many refinements to the oil gas process and contributing much to the industry. He won the P.C.G.A. Gold Medal in 1913 for a paper on oil gas and was vice-president of the Association in 1920. Among his latest work was the design and construction of the present efficient plant of the Honolulu Gas Company. Shortly thereafter he went to England to build a plant in Wales. This plant led to others and resulted in the formation of a British company, the Jones Gas Process Co., Ltd. which occupied him until the time of his death.

Celebrates 40th Year with Gas Utility

F. F. Ingwall, vice-president of the Binghamton Gas Works, Binghamton, N. Y., who recently celebrated his fortieth anniversary with the company. Starting work at 18 when illumination was the No. 1 gas job, he and the company have grown up together, the latter from 5,000 to 31,000 customers, with the volume of gas jumping to 20 times the send-out of 40 years ago. Mr. Ingwall is vice-president not only of the Binghamton company but also of the Keystone Gas Co., Home Gas Co., and Eastern Pipelines. He was awarded a gold watch on the occasion of his anniversary.

Passes 25-Year Mark

Elmer F. Schmidt

ELMER F. SCHMIDT, vice-president and operating manager, Lone Star Gas Co., Dallas, Texas, celebrated his twenty-fifth anniversary with the company on April 1.

Mr. Schmidt went to Lone Star on April 1, 1918, when he took charge of the gas measurement department. He has served successively as chief engineer, general superintendent, director and vice-president in charge of production and transmission. He is a native of Binghamton, N. Y., and a graduate of Cornell University.

A past chairman of the Natural Gas Section, American Gas Association, Mr. Schmidt has made many valuable contributions to the gas industry.

Gas Technology Has Woman Recruit

THE first woman has been added to the research staff of the Institute of Gas Technology at Illinois Institute of Technology in Chicago. She is Frances Estes.

Miss Estes is employed as a laboratory technician and does her work alongside the 26 men who are also on the staff. She thus successfully invades a field that hitherto has been reserved for men.

The new staff member was graduated from Kalamazoo College in 1940 with a major in chemistry. Before going to the Gas Institute, she was employed in the laboratories of Johnson & Johnson. In addition to her work, she is studying for her master's degree in chemistry.

Frances Estes, first woman to work on the Gas Institute research staff, making a volumetric analyses of gases

CONVENTION CALENDAR

MAY

May 4 **A. G. A. Motor Vehicle Conference**
Pennsylvania Hotel, New York, N. Y.

4 **Pennsylvania Gas Association**
Philadelphia, Pa.

6 **American Standards Council**
New York, N. Y.

10-14 **National Fire Protection Association**
Palmer House, Chicago, Ill.

12 **Gas Meters Association of Florida-Georgia**
Tampa, Fla.

13 **Indiana Gas Association**
Claypool Hotel, Indianapolis, Ind.

24-25 **A. G. A. Production and Chemical Committee Conference**
Hotel Pennsylvania, New York, N. Y.

JUNE

June 7-9 **National Office Management Association, Annual Conference**
Detroit, Mich.

OCTOBER

Oct. 5-7 **National Safety Congress**
Hotel Sherman, Chicago, Ill.

NOVEMBER

Nov. 29-Dec. 3 **American Society of Mechanical Engineers**
New York, N. Y.

Accounting SECTION

L. A. Mayo, *Chairman*
O. H. Ritenour, *Vice-Chairman*
O. W. Brewer, *Secretary*

Accounting for Post-War Refund of Excess Profits Tax

By H. B. Heiby*

Chairman, Taxation Accounting Committee

THE 1942 Act, approved October 21, 1942, has added to the Internal Revenue Code a feature new in American income taxation. This new feature (as set forth in sections 780 to 783, inclusive, of the Code) provides for a post-war refund of excess profits tax equal to 10% of such taxes paid. This credit may be used, with certain limitations, to reduce the amount of excess profits tax payable if there has been a retirement of debt during the taxable year as defined in Section 783. It is provided that non-interest bearing Government Bonds will be issued to taxpayers to cover the post-war credit and that such bonds shall not be negotiable in any respect until after cessation of hostilities. These bonds will be redeemed after the war in accordance with the schedule set forth in the Code under Section 780.

Accounting Approach

The enactment of this feature of the Internal Revenue Code presents a problem in accounting with which we have not heretofore been confronted, and like many accounting problems it must be approached from the viewpoint of the character of result that is sought to be attained. Among the possible accounting results, the following present themselves for consideration:

1. A net income (interim) that has been arrived at after the deduction from gross income of the gross amount of the tax with no offset for any part of the post-war credit, whether or not there will have been a retirement of indebtedness[a] before the end of the year such as may be availed of under Section 783.

2. A net income that has been arrived at after the deduction from gross income of the net amount of the tax after applying only so much of an offset, if any, as has been actually earned through the retirement of indebtedness, without the application of any offset for the remainder of the post-war credit for which the taxpayer will be entitled to receive bonds in due course.

3. A net income that has been arrived at after the deduction from gross income of the net amount of the tax after applying as an offset the entire post-war credit of 10% that will eventually be realized.

The net income arrived at by the accounting treatment suggested under (1) above will, of course, be the most conservative of the three methods suggested. The book entries would involve a charge to expense of the gross tax liability, and a credit of the same amount to accrued taxes. If there is a retirement of indebtedness prior to the close of the taxable year there would be a charge to accrued taxes and a credit either to taxexpense or to miscellaneous income. Upon the subsequent receipt of bonds there would be a charge to an appropriately titled asset account and a credit (a) to surplus (b) to miscellaneous income, or (c) to a deferred credit account.

The amount of the entry on account of the retirement of indebtedness would be equal to the full amount of the credit as allowed, but the amount of the entry on account of the receipt of bonds would be either the par value of the bonds, or the then estimated present worth, the amount of the discount in the latter case to be spread over the remaining period to the date upon which the bonds will become payable. While hostilities continue, that remaining period and that date would have to be estimated; after hostilities have actually ceased, that period and the due date will be definitely fixed. If, pending the actual receipt of the bonds, the taxpayer wishes to record on the books of account his right to receive such bonds, the entry would be a charge to a suitable Deferred Asset account with an offsetting credit, in equal amount, to the above-mentioned deferred-credit account.

The net income arrived at by the accounting treatment suggested under (2) will differ from the result under (1) only to the extent that in (2) credit will have been taken currently for any indebtedness payments expected to be made before the end of the taxable year.

If the accounting procedure suggested under (3) is followed, the net income will be the greatest among the three procedures enumerated. In the case of corporations that are subject to governmental regulation to the extent of that experienced by public utilities, it seems reasonable to believe that this procedure might be obligatory, whether this maximum net income is arrived at through the medium of (a) expensing only the ultimate net tax; (b) expensing the net tax after taking immediate credit for only the indebtedness paid off, and then crediting miscellaneous income for the amount of the bonds that will be received; or (c) expensing the gross tax and crediting miscellaneous income with the gross amount of the credit.

Public Utility Procedure

The following is suggested as possibly meeting the requirements of public utilities in general:

A. Tax expense to be charged with the net tax which the taxpayer reasonably believes might ultimately be paid up to and including the final settlement of the return.

B. A deferred asset account to be set up equal to whatever post-war credit the return is expected to indicate after the application of the credit for debt retirement.

C. Either the Accrued Taxes account or a combination of the Accrued Taxes account and a Contingent Reserve (for undetermined taxes) account to be credited with an amount, or amounts, equal to the total of the two charges under (A) and (B).

D. As soon as the tax return is prepared and the taxpayer has determined his tax liability for the year, entries should be made to bring the balance sheet accounts into agreement with the return.

E. When the bonds are received the deferred asset account will be cleared to some other appropriately titled asset account. If, upon final settlement, the excess profits tax liability is determined to be an amount different from the liability disclosed by the return, and settlement is made at a date prior to the applicable bond maturity date designed by the Code, then the asset account (and Surplus or the deferred credit account suggested in paragraph F below) will need to be adjusted to record the change in the amount of the bonds.

F. In order to preclude the possibility of the declaration of dividends from earnings not realized nor immediately realizable it is suggested that so much of what would ordinarily constitute earned surplus as equals the amount of the above mentioned

* Supervisor, Tax Department, Columbia Engineering Corp., New York, N. Y.

[a] That it is important to weigh the possibility of making such payment is evident from the fact that *interest-bearing* indebtedness would thereby be disposed of at the cost of the right to receive *non-interest-bearing* notes.

deferred asset (or other asset account, if the bonds have been received) be set aside either as appropriated surplus or as a deferred credit until the bonds have been realized.

In the schedule which accompanies this article an example of the entries suggested in the foregoing paragraphs is set forth by the use of assumed circumstances and amounts as indicated in the schedule.

The Securities and Exchange Commission, on December 19, 1942, made public an opinion of its Chief Accountant in its Accounting Series relative to the manner in which post-war refunds of Federal excess profits taxes should be treated in financial statements. The opinion, prepared by William W. Werntz, Chief Accountant, in response to an inquiry, follows:

"You have inquired with respect to the propriety of the manner in which the company proposes to reflect in its financial statements the post-war refunds of Federal excess profits taxes which are provided for by Section 250 of the Revenue Act of 1942. You state that the corporation's tax return will indicate that the corporation will be subject to an excess profits tax of $1,000,000, that the company will therefore be entitled under the statute to a post-war refund credit amounting to $100,000, and that within three months after the payment of the tax the company will be entitled to receive bonds of the United States in an aggregate face amount equal to the credit so established. You note that the Act provides that such bonds shall bear no interest, and only after, and not before, cessation of hostilities in the present war may the bonds be transferred by sale, exchange, assignment, pledge, hypothecation, or otherwise.

Accounting Conference

THE joint meeting of gas and electric industry accountants, held April 27-28 in Cincinnati, Ohio, will be summarized in the June issue of the A. G. A. MONTHLY. The conference was sponsored by the American Gas Association and the Edison Electric Institute.

"As I understand it, you propose to deduct in your profit and loss statement excess profits taxes in the amount of $900,000 the net amount of such taxes ultimately payable. However, disclosure will be made of the gross amount of the tax and of the net credit there against. Concurrently, you propose to set up an asset account in the amount of $100,000 to reflect the amount receivable as a post-war refund and to reflect $1,000,000 as a current liability. When bonds are received the caption of the account will be altered to indicate that fact. You thus purpose to treat the total amount payable as, in effect, partially a payment of taxes and partially, to the extent of the post-war credit, as an investment in a special type of government bonds.

"Upon the basis of the facts stated, the treatment you propose is, in my opinion, in accordance with sound and generally accepted accounting principles and practice and should be followed. However, in view of its special characteristics, the amount receivable as a post-war refund should not, in my opinion, be presently classified as current assets or investments, but should rather be shown among 'other assets.'"

The Federal Power Commission recently

(Continued on page 216)

SCHEDULE ILLUSTRATING ENTRIES SUGGESTED IN PARAGRAPHS A TO F, INCLUSIVE

Paragraph	Assumption			Debits: Tax Expense $	Debits: Deferred Asset $	Debits: Other Asset $	Debits: Surplus $	Credits: Accrued Taxes $	Credits: Contingent Taxes $	Credits: Appropriated Surplus $
A	Final tax liability provided for:									
	Gross E. P. Tax		$300,000							
	10% Credit		30,000							
			$270,000	270,000						
B	Amount of post-war credit the return is expected to indicate, after the application of the credit for debt retirement:									
	Gross E. P. Tax		$260,000							
	10%		26,000							
	Credit for debt retirement		6,000							
			$ 20,000		20,000					
C	Tax liability return is expected to indicate, after the application of the credit for bond retirement, but before deducting other post-war credit:									
	Gross E. P. Tax		$260,000							
	Credit for debt retirement		6,000							
	Amount expected to be paid to Collector		$254,000					254,000		
	Balance (A plus B minus C)								36,000	
D	Completed return shows:									
	Gross E. P. Tax		$262,000							
	10%	$26,200								
	Credit for debt retirement	6,000	6,000							
		$20,200	$256,000							
	Previous estimate (see above)	20,000	254,000							
	Adjustment	$ 200	$ 2,000		200			2,000	(1,800)*	
E	Bonds received				(20,200)*	20,200				
	Final Settlement:									
	Gross E. P. Tax		$301,000							
	10%	$30,100								
	Return showed	26,200	262,000							
	Adjustment	$ 3,900	$ 39,000			3,900	900	39,000	(34,200)*	
F	Entries pending realization of bonds:									
	On basis of return						20,200			20,200
E	Final Settlement						3,900			3,900
—	Totals			270,000	-0-	24,100	25,000	295,000	-0-	24,100
—	Additional liability charged Surplus			900						
—	Credit for debt retirement			6,000				6,000		
—	Bonds acquired			24,100						
—	Gross tax per final settlement			301,000				301,000		

*Italics, ( ), indicate reductions.

Domestic Gas Research Program Being Revamped

E. J. Boothby

THE American Gas Association's Committee on Domestic Gas Research has undertaken a complete revamping of the program of research being carried on under its supervision. Five projects are on the agenda and it is the committee's determination to speed the work materially and to readjust the projects so that they will constitute only work that is of the greatest practical value in connection with post-war appliances.

These research projects cover:

1. Domestic Gas Cooking
2. Domestic Gas Water Heating
3. Fundamentals of Atmospheric Gas Burner Design
4. Direct Gas Space Heating
5. Central Gas Space Heating

For each of the major projects there is a Technical Advisory Committee composed of leading equipment manufacturers and utility engineers who are working on details of the revised and expanded research program. These Technical Committees are studying not only the results of the research conducted in their respective fields up to this time—both published and unpublished—but are reviewing dozens of recommendations and suggestions that have been received from many sources.

The committee is determined to enlarge its program so as to run down more unsolved problems and to do this as rapidly as possible. The whole subject was reviewed at a meeting March 29 and the enlarged, speeded-up program will be completed at a meeting on April 26. Recommendations will be presented to the Executive Board immediately following that meeting.

Boothby and Banks Head Committee

President Arthur F. Bridge has appointed two active leaders of the gas industry to head the Committee on Domestic Gas Research. E. J. Boothby, vice-president and general manager, Washington Gas Light Company, is chairman and F. Marion Banks, vice-president, Southern California Gas Company, is vice-chairman. Both men have had wide experience in the gas industry and are well qualified to conduct this vital activity.

A native of Somerville, Mass., and a graduate of Tufts College in 1915, Mr. Boothby applied his chemical engineering training for seven years, first with the New England Manufacturing Co. and then with the Atlantic Dyestuff Company. In 1922, he became associated with New England gas companies under the management of Stone & Webster, being appointed superintendent of manufacture, Fall River Gas Works Co., manager, Lowell Gas Light Co., and, later, to the staff of Stone and Webster Engineering Corporation.

Following a brief absence from the utility field in 1931, when he became vice-president of the Troy Laundry Machinery Co., East Moline, Ill., he became vice-president of the Washington Gas Light Co. and subsidiary companies, in 1932.

In the nation's capital, Mr. Boothby has assumed a position of business leadership, being vice-president of the Merchants and Manufacturers Association, a director of the Washington Building Congress and a trustee of the Better Business Bureau, as well as a member of the Kiwanis Club.

He is a member of the A. G. A. Committee on Post-War Planning and a member of the Society of Gas Lighting.

Banks' Career

Mr. Banks is a graduate of Massachusetts Institute of Technology, 1922, with a B.S. degree in electro-chemical engineering. During the last war he attended officers' training camp, Coast Artillery, at Fort Monroe, Virginia.

He began his career in the gas business in 1922 in the engineering department of Southern California Gas Company, being transferred in 1923 to the eastern division in charge of residential, power and industrial sales. In March, 1926, he became general sales supervisor for the company. Following his return to the general office at Los Angeles in 1927, Mr. Banks was appointed assistant general manager of three recently acquired San Joaquin Valley properties of the system, namely, Riverbend Gas and Water Co., Hanford Gas and Power Co., and Central Counties Gas Co., with headquarters at Visalia, California. He was in charge of these properties in 1929 when they were converted from oil gas to serve natural gas brought from Kettleman Hills.

F. Marion Banks

In July, 1930, Mr. Banks returned to the general office as general superintendent, in charge of advertising, sales and public relations. In 1934 he was elected vice-president in charge of the above activities. When the company merged with Los Angeles Gas & Electric Corp. in 1937, he was elected vice-president in charge of advertising, sales and public relations together with customer accounting, billing, and other activities. He has been a director since 1934.

Prominent in A. G. A. affairs for a number of years, he is a past chairman of the Residential Section.

Associated with Messrs. Boothby and Banks on the Committee on Domestic Gas Research are: Frank H. Adams, Surface Combustion, Toledo; R. L. Fletcher, Providence Gas Co., Providence, R. I.; R. G. Barnett, Portland Gas and Coke Co., Portland, Ore.; Henry O. Loebell, New York; Christy Payne, Jr., The Peoples Natural Gas Co., Pittsburgh; H. P. J. Steinmetz, Public Service Electric and Gas Co., Newark, N. J.; Charles H. Wiley, The Laclede Gas Light Co., St. Louis; and W. F. Wright, Lone Star Gas Co., Dallas.

Mid-West Gas Sales Forum Held

THE second roundtable forum for mid-west gas company sales managers, sponsored by the Mid-West Regional Gas Sales Council of the Residential Section, American Gas Association, was held April 5 at the Palmer House, Chicago. Approximately 40 sales managers took part in a vigorous discussion of war and post-war sales, servicing and advertising problems. The meeting was considered so constructive that a similar forum has been planned tentatively for the Fall.

J. C. Sackman, general manager, Northern

Indiana Public Service Co., Hammond, Ind., and chairman of the council, led the discussion. Among the subjects reviewed were: service and repair programs, customer survey activities, War Bonds for future purchase of gas appliances, nutrition program, limitation orders, CP range, advertising and sales department reorganization to conform with manpower situation.

Booklet on Wartime Home Service

A NEW booklet, "Wartime Home Service," just published by the Home Service Committee of the American Gas Association, gives the latest data on the work of gas company home service departments in promoting wartime programs of nutrition, equipment, fuel and food conservation.

Compiled by a subcommittee under the direction of Susan Mack, home service director, Boston Consolidated Gas Company, the booklet summarizes the results of an industry-wide questionnaire, pointing out that 12 million contacts were made by home service departments in 1942.

As indicated by Jeannette Campbell, chairman of the Home Service Committee, this publication shows the overwhelming community acceptance on utility home service work.

"Wartime Home Service" supplements the booklet "Home Service Volunteers," published last year, which is still available at 15¢ a copy from the American Gas Association, 420 Lexington Ave., New York, N. Y. The new booklet may be secured for 10¢ a copy.

It's How You Say It

FRANCIS BACON, or somebody equally profound, said that the resourcefulness and energy of a people is reflected in the inventiveness of its tongue; also, that static speech is a sign of retrogression and decay—or words to that effect. If that is the case the gas industry's home service departments are bursting with vitality for they have shown great originality and adaptability of terminology since the war began.

For instance, we have current radio programs called "Women Commandos" (Oklahoma Natural Gas Co.), "What's Cookin' Neighbor" (Roanoke Gas Co.) and an employee course "Victuals for Victory" (The Ohio Fuel Gas Co., Columbus). Then there are such booklets as "Meatless Meal Maneuvers" and "Miss Sugar Shy" (Wisconsin Public Service Corp.), "Menus for the Army in Aprons" (Republic Light Heat & Power Co., Buffalo) "How to be Happy Tho' Rationed" (Worcester Gas Light Co.), "Cookery Communiques" (Oklahoma Natural Gas Company) and our own A.G.A. publication, "Uncle Sam Wants It to Last."

That is just a sample, and the list may be extended indefinitely.

Home Volunteer Program Extended

The Michigan Consolidated Gas Company gets behind the new nationwide Servel radio broadcast "Fashions in Rations" starring the famous Billie Burke

TO meet the increasingly complex food problems of homemakers created by the point system of rationing, the Home Volunteer Program, now serving 12,000,000 women through 450 gas companies, has been redesigned and extended.

A portfolio—"The Home Volunteer Wartime Food and Nutrition Program"—outlining plans for the extended program, has been developed by Servel, Inc., of Evansville, Ind., and is now being made available to cooperating gas companies, it has been announced by George S. Jones, Jr., vice-president and general sales manager of Servel.

The program has been developed around three basic booklets: "Eating for Fitness," "Planning Your Own Nutritious Meals," and "Getting the Most Out of the Foods You Buy."

As part of this new, extended program, Servel has inaugurated a unique type of radio show in cooperation with local gas companies: "Fashions in Rations," starring Billie Burke as the entertainment feature, goes on the air every week on a coast-to-coast CBS network of 68 stations, bringing to homemakers everywhere the latest and most authentic national and local facts on food and rationing. Gas companies "cut in" to present local market trends and available foods, through their home service directors.

An important feature of the "Home Volunteer Wartime Food and Nutrition Program" is the "Home Volunteer Refresher Course." This consists of special News Letters written by J. Ernestine Becker, nationally recognized authority on nutrition and health, who heads Servel's Advisory Board on the Home Volunteer Program. Through these Letters, home service directors, home volunteer consultants, and others concerned with giving the new program as a course, are kept up to date on all important developments and trends in nutrition, and in the rationing situation.

Contents of the three booklets on which "The Home Volunteer Wartime Food and Nutrition Program" is based, follows:

Booklet I—"Eating for Fitness"—explains in simple language what nutrition is, how it may be applied, using the U. S. Government Food Rules or the "Basic Seven," and provides new tested, balanced "Victory Menus" planned in accordance with the official food rules and current rationing allowances.

Booklet II—"Planning Your Own Nutritious Meals"—shows how to plan meals with the use of the Home Volunteer Meal Planner Blank. The problems of variety in foods, home meals, lunch boxes, use of food "alternates" and "Equivalents," food selection and purchasing and budgeting "points" are covered.

Booklet III—"Getting the Most Out of the Foods You Buy"—describes the simple steps that may be taken both to avoid food losses caused by spoilage and losses of nutritive values. The "Do's and Don'ts" of food handling, storage, preservation and preparation are covered for all food groups in the "Basic Seven."

Convention Off

THE convention of the American Home Economics Association, scheduled for St. Louis, Mo., June 18-21, has been cancelled.

EXCESS PROFITS TAX ACCOUNTING

(Continued from page 214)

issued the following instructions to natural gas companies:

"The Commission's attention has been directed to the fact that in reporting taxes in Schedules 274 and 470 of the Commission's Annual Report, F.P.C. Form No. 133, some companies heretofore have combined Federal Income Taxes and Federal Excess Profits Taxes.

"For 1942 and subsequent years, Federal Income Taxes should be reported separately as to Normal Taxes and Surtaxes, The Federal Excess Profits Taxes should be so reported as to show the accounting made for the amount subject to post-war refund by the government. Only the net amount of Federal Excess Profits Taxes should be charged to Taxes; the amount refundable by the government should be included in Account 112, Other Investments."

Industrial & Commercial Gas SECTION

B. H. Gardner, *Chairman*
Charles G. Young, *Vice-Chairman*
Eugene D. Milener, *Secretary*

The Future of the Portable Gas-Fired Baking and Roasting Oven

By Daniel C. Brogan*

Sales Manager, The G. S. Blodgett Co., Inc., Burlington, Vt.

As clearly defined as the milkman's tracks in an early morning snow, is the post-war future of the gas-fired portable baking and roasting oven. And it is good to give thought to that idea now; for while every American wheel and machine must, at the moment, turn only in war production, and may for some time to come, we must allot some space on our mental drawing board to thought and planning for the days which will follow victory.

Each one, revolving within his own sphere the thoughts peculiar to that orbit, generating improvements and advancement over what we have known and have had, is part of the American essence. As a nation, we've always done that; and it is the composite of those individual spheres that make up the economic life of the nation.

Surely, we have not gone into this conflict merely to maintain a status quo, a stagnant civilization; that would in reality be retrogression. In like manner we have no desire to experience an hiatus of national economic amnesia. Instead of picking up where we left off, we will restart *where we would have been had we not been disturbed in the peaceful pursuit of our way.* It is, therefore, "truly meet and just, right and availing to salvation" that we raise our minds to the things that are to come, even in the midst of the stupendous job now on our hands, and even in the sorrow that will visit many of our homes before victory is assured.

What may sound like a digressing preamble to the "future of the portable gas-fired baking and roasting oven," really, upon sober thought, is not. There is sound reason for anticipatory post-war planning—today.

Since there is no place for isolationism in national economics, the portable baking or roasting oven cannot move alone along the forseen road. It may lead the van; its place may be among the latter ranks; but in the parade must and will be all gaseous fuel equipment—and the fuel itself.

Promotional media—advertising and leg work—should therefore play strong light upon the advances that gas, and gas-fired equipment will have made before the end of the war, so that those then in need of commercial cooking and baking machinery—and that will include most places—will know that available to them will be technology, appliances and applications modern as of that date—not now, not a year ago. We ought not to fall into the error of advertising John Jones' kitchen, or that of the hotel so and so, installed in 1941, as a kitchen that will be modern after the war because it will not be so.

We base that conclusion upon premises the solidity of which we are convinced:

1. Kitchen and bakery equipment engineers and consultants have learned considerable during the last two years, and that experience is bound to change—in fact, it has changed—their appreciation of fuels, appliances and layouts.
2. Many concerns which had but superficial knowledge of kitchen engineering and equipment have, because of Federal dispersion of contracts, gained first hand working knowledge.
3. More and wider use of "specialized" cooking equipment than ever before has spread the gospel of this phase of commercial cookery.
4. Manufacturers, though deeply engaged in war production, have kept up improvement of their equipment, some on the drawing board it is true, but many in actual practice.

Roasting Ovens vs. Baking Ovens

While these marks characterize the entire industry, they are notably dominant in the portable gas-fired baking and roasting oven. To focus the picture clearly let us look first at the portable roasting oven.

One of the faults most difficult to overcome in connection with the past promotion of portable gas ovens was their identification as "baking" ovens. The tag was so solidly appliqued that it is difficult even

*Member A. G. A. Food Service Equipment Committee, Industrial & Commercial Gas Section.

At left are two modern, thermostatically-controlled gas bake ovens donated to the Food Trades Vocational High School in New York by The G. S. Blodgett Co., Inc.

Below is the salesroom of Florence Pastry Shop, New York City, where seven bakers and six sales ladies are required to take care of the production of one six-shelf insulated cabinet gas oven

Top-notch food, plus modern equipment and cooking technique keeps WAVES well fed—Battery of modern gas roasting ovens installed in "ship's galley" at Hunter College

now to tear it off. Since competitive fuels did not make the same mistake, they cut good-sized chunks out of the gas roasting business—with "roasting" ovens.

An axiom that may be kept in mind for the future is this: A gas portable oven will bake delicate cakes and pastries well; it must, it follows, be a good unit for roasting. A truism well recognized now, it will have a salutary effect on gas-fired roasting in the future.

The war has also given us an opportunity which would have been ours only through a long succession of years—to amplify and expand the menu possibilities of roast oven work—with foods and dishes that could not be prepared in the older layout, occasionally because of equipment shortcomings or limitations but most frequently because of the failure of gas promotion to study and make effective use of the specialized cooking equipment that was on the market.

Promoting Specialized Equipment

The work of promoting the use of specialized cooking equipment—vegetable steamers, fryers, roasting ovens and other appliances, has been honored with unusual success. Hundreds of restaurant men, now in the armed forces, on hospital duty, operating war plant units, have had indelibly impressed upon them the efficacy of the "specialized cooking" idea—favorably for gas fuel, because it is the only fuel that provides both the equipment and the flexibility to make the idea work.

Again, restaurant, hotel and institutional operators who have been forced by the necessity of scarcity to develop "substitute" dishes, to conserve foodstuffs, to think *in terms of services* about meats and other products, will in the future continue to think in those terms, not entirely from necessity but with an eye toward profit.

The portable gas-fired roasting oven will get prominent billing on that poster. Most of this new roasting load will be "additional."

Primarily, for the reasons enumerated above, the portable gas roasting oven will be a colloidal agent in the jelling of public acceptance of the "specialized" cooking tool idea. The restaurant or volume feeding kitchen of the future will abandon the old idea of Jack-of-all-trades appliances.

Many technical advances are already in these units—easier, simpler operation, single control for each section or oven, instead of a multiplicity of gas valves and knobs, ease of cleaning; lower input, thicker, more effective insulation, utter simplicity of service, are a few. Refinements of these features plus new ideas entirely are in the stage at which they can be put into production.

Research and field study, in progress for some time, and to be continued, have indicated new landmarks in commercial cookery practices. Awkward oven sizes, placed in awkward spots, are already beginning to vanish, dimmed by the ease, capacity and flexibility with which the seven and eight-inch compartment clearances, combined with eleven- and twelve-inch clearance units, operate.

In other words, present experience undeniably points to increased use of food preparation tools *designed* for their specific tasks; to amplified menu names and delightful and healthful dishes prepared in mass production because of those cooking tools which gas has provided, but which it has failed fully to recognize. And not the least of these is the portable roasting oven.

When the Bakers Come Marching Home

Not all the far-off views of the portable gas-fired oven as used for baking have yet cleared sufficiently to discuss them now. Yet, there are some well defined indications of much broadened sales.

Coming home from the wars will be a large army of bakers, well trained and experienced. Supplementing them will be a numerous group of bakers and patisserie men with technical and vocational school training. Few will establish immediately their own shops; most will flow into a reservoir of labor for the commercial cooking and baking industries. But as a sign of the times, their knowledge will be modern, planned and worked out with the daring anticipation of the army and navy baking schools.

There was a strong revival of trend before Pearl Harbor to the neighborhood bakery. Those that survive the strictures of wartime economy will have found that the public appreciates craftsmanship and will crowd in long queues of patronage the places which produce what the public likes. We can name dozens of such new shops that are operating now—and can easily visualize them as spread through cities and hamlets with the frequency of taverns.

The mark of the new neighborhood baker will be variety. The present gas-fired portable oven has already answered his demand for extreme flexibility. That will be enhanced and broadened with still faster units and controls that will hug temperatures more closely than even now.

Restaurants and institutions will find twofold use for portable ovens—in their striving to meet public demand for freshly baked goods of the same variety as the customer can get home, and in what we believe will be a permanent result of the war—the replacement of canned desserts by oven-processed sweets, dainties and puddings. It's an ill wind that blows no one good—and the gas promotion men should not fail to capitalize on the wind that blew in the canned goods shortage.

Retarded Dough Will Grow

There are numerous other factors which add up to a sizeable public interest in portable baking ovens—common use of retarded doughs; the success of nationally known chains and individual restaurants in serving goods baked on their premises under their own control; plentiful labor—are

(Continued on page 220)

INDUSTRIAL AND COMMERCIAL GAS ADVERTISING FOR MAY

The National Advertising Committee of the Industrial and Commercial Gas Section, J. P. Leinroth, chairman, and F. B. Jones, vice-chairman, announces that full page advertisements will appear in the trade and business magazines listed below during the month of May. These advertisements are prepared in cooperation with the Committee on National Advertising as a part of the industry's national advertising campaign.

Magazine	Theme
General Advertising	
Business Week (May 15—⅔ page)	The American "blitz" starts here! *GAS* and the proper heat treating of *parts* set the pace for ultimate victory in the field.
Metals Industry	
Steel (May 17) Industrial Heating Metal Progress	To "keep 'em rolling" in the air calls for *GAS* heat-treating.
Baking Field	
Bakers Weekly (May 24)	Ever sold any GI Bread? *GAS* helps bake it, too!
Ceramic Industry	
Ceramic Industry	"Seems like *GAS* does everything!"
Restaurant Field	
American Restaurant	Green help? It's less of a problem with *GAS* equipment.

Gas Pressures and Gas Flow

Notes for Manufacturers and Designers of Gas-Burning Equipment

By C. G. SEGELER

Engineer of Utilization, American Gas Association

COMMERCIAL and industrial gas appliances, furnaces, and other apparatus having gas equipment attached thereto are manufactured in many different parts of the United States. It is quite natural, therefore, that the designers and builders think in terms of the kind of gas which they have locally at their disposal. To be sure, some of the companies having extensive and far-flung gas business soon become familiar with the differences of gases available in various cities but, on the other hand, some companies have not taken advantage of the available information. The result of this omission has been the construction of numerous gas appliances which worked splendidly on the local gas but which did not furnish completely satisfactory service on all of the fuel gases with which they are likely to be supplied, depending on the location where the equipment is used.

The purpose of this brief write-up is to draw the attention of manufacturers to this situation and to indicate certain details to be observed so that equipment may perform exactly as originally designed.

Gas Input Rating

One of the primary factors in the design of an industrial and commercial appliance is its gas input rating. This should always be expressed by the manufacturer in terms of B.t.u. per hour, and the name plate should carry this information so as to enable the installer to make a proper adjustment. The name plate should also carry identification data, such as appliance serial and type numbers.

In order to secure the correct supply of gas for the operation of the equipment, it is necessary that the gas piping, the valves, and the controls be of such a capacity that an adequate supply of gas at an adequate pressure will reach the burners. (Not all valves and controls of the same pipe size have the same capacity.) This is a phase of design to which the American Gas Association Testing Laboratories have given a great deal of attention, and strict requirements have been set up for such domestic and commercial gas appliances as are subject to the Approval Requirements issued by the American Gas Association under the auspices of the American Standards Association. In the industrial field and in many branches of commercial applications of gas, no such Approval Requirements are in existence nor would it be practical to draw up requirements for all such equipment. It is in these fields that the builders of equipment may find guidance of value since they do not have the benefit of the appliance approval plan. The local gas company will gladly furnish data as to type of gas, the specific gravity and pressure, and other local conditions.

The problem of gas flow is attacked by starting at the burner itself and determining what gas pressure must be available at that point in order to give adequate service. If the burner is to operate on low pressure atmospheric gas, the minimum pressure at the burner spud for satisfactory manufactured gas operation is about 3 in. water column. If the burner is of a proportional inspirating type connected to the gas lines by means of a zero governor, then the pressure just ahead of the zero governor must be about 3 in. water column in order to assure a proper supply of gas. (This is not an iron-clad rule since the use of an over-sized governor and burner might make it possible to get along with a lower pressure. Increased cost due to this equipment does not always justify such a procedure, and the proper basis is to design piping and controls ahead of this point so as to secure adequate pressure.) The figure of 3 in. water column is valid for most manufactured gas applications, but in the case of natural gas or mixed gas, there should usually be about 5 in. of water column available at the burner spud. In general, designing the size correctly for manufactured gas automatically will take care of the problem for mixed and natural gases because of the smaller volume of such higher heating value gases required to furnish the rated B.t.u. input. It is self-evident that it only takes 1 cu.ft. of 1100 B.t.u. gas to do the same work as 2 cu.ft. of a 550 B.t.u. gas.

One large gas company reports that six different instances were noted during the past two years in which ovens and furnaces had been designed by various manufacturers on the basis that 6 in. w.c. pressure would be available at the main shut-off valve whereas the particular location in which they were installed was such that this pressure could not be furnished and that 3 in. was the best available. As a result of such a difference in pressure available at the furnace, the flow of gas is reduced to 71% of the necessary volume.

$$\left(\sqrt{\frac{P_1}{P_2}} = \sqrt{\frac{3}{6}} = .71\right)$$

It is self-evident that a drop of 30% in the expected gas capacity will interfere seriously with the performance of the equipment. This drop can only be overcome by expensive alterations or modifications which would not have been necessary if the original design had been based on the probability that such low pressures would be encountered in the field. The use of boosters or blowers in the furnace design does not necessarily overcome pressure deficiencies.

The pressure drop which the appliance manufacturer must consider starts back at the meter in the plant in which his equipment is to be installed. If the assumption is made that manufactured gas companies generally supply gas at about 4 in. or 5 in. pressure at the mains, then it is fair to assume that there will be a loss of about ½ in. pressure from the meter to the point at which the equipment is placed. The valves and controls and piping on the furnace should then be selected with such capacity that adequate gas pressure, defined in this write-up as 3 in. w.c., is available at the burner. In areas where lower gas pressures are carried in the street mains, these pressure losses assume critical importance.

In a recent test of one industrial furnace made by a large and well-known manufacturer the pressure losses from the main control valve were as follows:

0.4 in. through plug cock;
0.4 in. through plug cock;
1.1 in. through the solenoid valve;
0.1 in. through the control section of the piping,

making a total loss of 2 in. through the equipment accessories. Larger piping and controls would have reduced this pressure loss materially and saved delay and complaint regarding the performance of the equipment. If this furnace is installed where there is 4 in. pressure in the gas mains, the pressure available at the furnace would be less than 2 in., which is inadequate. In addition, it is sometimes necessary to install back pressure or vacuum valves, which cause additional pressure loss.

How To Determine Proper Size*

In order to secure adequate gas pressure at the burner, the total pressure drop at full gas rating should be estimated by adding together the drop caused by each element in the system. This usually means that the pressure loss caused by (1) piping, (2) fittings, (3) main control plug cocks or valves, (4) pressure regulator, (5) solenoid valves, (6) motorized valves, (7) safety controls etc. must be evaluated and added.

The pressure drop through the entire equipment accessories should in general be held down to a maximum of 1 to 1¼ inches. The extra cost of larger piping valves and controls is fully justified to prevent troubles due to insufficient burner pressure.

Knowing the input rating of the furnace and the length of run, proper size of pipe may be readily obtained by reference to Table 1.

Each fitting may be considered as an additional equivalent length of pipe, as shown in Table 2. These lengths should be added

* Low pressure gas piping.

TABLE 1

PRESSURE DROP IN INCHES WATER COLUMN

Based on a length of ten feet,* and a specific gravity of 0.6†

Nominal Size of Pipe Inches	*Flow of Gas, Cu.Ft. per Hour*						
	50	*100*	*200*	*500*	*1000*	*2000*	*5000*
½	0.11	0.43	1.75	‡	‡	‡	‡
¾	0.014	0.054	0.22	1.38	‡	‡	‡
1	0.004	0.016	0.066	0.41	1.65	‡	‡
1¼	—	0.0038	0.0155	0.094	0.38	1.55	‡
1½	—	0.0016	0.0065	0.040	0.16	0.63	3.9
2	—	—	0.0016	0.010	0.04	0.16	0.95
2½	—	—	—	0.0038	0.015	0.06	0.36
3	—	—	—	0.0012	0.0047	0.0185	0.12

*For other lengths, multiply pressure drops shown above by $\frac{\text{length (feet)}}{10\text{ (feet)}}$.

†For other specific gravities, multiply pressure drops shown above by $\frac{\text{specific gravity}}{0.6}$.

‡Excessive drop: Do not attempt to use such small pipe.

NOTE: This table does not take fittings and controls into account. They should be calculated as shown in the following information.

TABLE 2

EQUIVALENT LENGTH OF PIPE IN FEET, CORRESPONDING TO VARIOUS FITTINGS

Nominal Size of Pipe, Inches	*Gate Valve*	*Long Sweep Elbow or Run of Standard Tee*	*Medium Sweep Elbow or Run of Tee Reduced ¼*	*Standard Elbow or Run of Tee Reduced ½*	*Standard Tee Through Side Outlet*	*Globe Valve*
½	0.4	0.5	0.6	1.0	2.2	3.3
¾	0.6	0.8	0.9	1.6	3.0	4.7
1	0.8	1.0	1.3	2.0	4.0	6.1
1¼	1.1	1.4	1.7	2.7	5.6	8.7
1½	1.3	1.7	2.1	3.4	6.8	10.5
2	1.7	2.2	2.9	4.5	9.1	13.8
2½	2.0	2.8	3.3	5.5	10.3	15.6
3	2.6	3.5	4.4	7.1	14.0	20.0

to the actual length of pipe, and the total used in working with Table 1.

Gas cocks with bores equal to the internal diameter of the pipe will cause pressure drops similar to gate valves. Avoid cocks with bores less than the inside diameter of the pipe.

In selecting proper sizes for various controls, reference may be made to the Directory of Approved Gas Appliances and Listed Accessories published by the American Gas Association Testing Laboratories. Capacities are shown for "listed" automatic pilots, pressure regulators, appliance thermostats, automatic gas shut-off valves, automatic main gas control valves, in this publication. They are based on a pressure drop of 0.5 in. water column at the rating indicated. Manual main gas-control valves are not so rated. They are, however, now required to have the capacities shown in Table 3 which may be employed as a guide.

If there are several valves and controls, the cumulative pressure drop may be excessive if all are operated at full capacity. By choosing valves and controls one size larger, the pressure drop will be reduced greatly.

This brief write-up has only dealt with the characteristics of gas pressure and flow as they influence design. Of course other factors, particularly the difference in the flame characteristics of the various gases, also must be considered by equipment manufacturers. This, however, is outside of the scope of the present discussion.

It is recommended that appliance manufacturers secure copies of the following books and papers dealing with these subjects:

1.) Bulletin No. 1, A. G. A. Testing Laboratory. "Flow of Gas through Orifices on Domestic Appliances," 40c.
2.) Research in Fundamentals of Atmospheric Gas Burner Design, A. G. A. Testing Laboratory Bulletin No. 10, $2.00.
3.) A. G. A. Requirements and Recommended Practice for House Piping and Appliance Installation, A. G. A. Testing Laboratory, 50c.
4.) American Standard Requirements for Installation of Gas Burning Equipment in Power Boilers, available from A. G. A. Testing Laboratory, 50c.
5.) Directory of Approved Gas Appliances and Listed Accessories, available from A. G. A. Testing Laboratory, 35c.

TABLE 3

CAPACITIES OF VALVES

Nominal Size of Valve Inches	*Required Capacity, B.t.u. per hr. 0.6 sp.gr., 500 B.t.u. per cu.ft. gas*
½	95,000
¾	255,000
1	435,000
1¼	645,000
1½	1,125,000
2	1,950,000
2½	2,500,000
3	4,350,000

Call on a Gas Oven for Mass Cookery

SEPARATE roasting ovens are becoming increasingly popular in hotel, restaurant, and institutional kitchens and several manufacturers of gas ovens have been specializing in this type of equipment recently.

To emphasize the broad scope of utility of roasting ovens, the magazine *Institutions* has prepared a list of foods served in mass feeding units which may be oven cooked. These include 31 beef items, 11 pork items, 9 types of shell fish, 32 other kinds of fish, 12 items of lamb and mutton, 19 vegetables, 4 meat substitutes, 10 poultry items, 14 puddings, 5 baked desserts and 7 fruits.

In addition to quantitative and qualitative angles of mass cookery, such factors as speed, economy, flexibility, reliability and ease of handling are important. The portable, sectional cabinet gas oven offers these advantages to those who prepare food in large quantities.

FUTURE OF PORTABLE OVEN

(Continued from page 218)

just a few. If the work of promotion and publicity is not allowed to lag, every restaurant will find that baking, roasting or combination baking and roasting portable ovens are as important as cash registers.

We *have* painted a roseate picture of the future, true. But there is a rather dominant "if" in the setting. These broadened uses of portable ovens, and the improvements in the ovens themselves, will not come to live long beyond the diaper stage as far as gas fuel is concerned unless gas industry management—and we do not mean commercial-industrial sales managers, but the executives who hold the purse strings—awaken to the fact that commercial cooking gas must be merchandised even more than the equipment that uses it. Any idea that the fuel send-out for that use is there by any God-given right, and there to remain, is wrong now; it has been wrong, and will, in the future, be wrong. Eternal vigilance is the price that must be paid for keeping many things—liberty and gas loads included. Patrols cannot be kept watching if their numbers are non-existent or cut down to ineffective quantity. Gas executives must get away from the conception that commercial fuel men are among the expendables.

Manufacturers of equipment will not be able to carry the load of two-fold promotion, that for a fuel and that for their equipment. And most sales outlets do not interfere in fuel problems. It is dynamite for them—they're not anxious to handle it.

Gas Production and Chemical Conference To Untangle Problems of War Origin

T. L. Robey
Chairman,
Chemical Committee

HIGHLIGHTING the important contributions of gas engineers and chemists to the war effort and unraveling some of the more vital knots resulting from material and manpower shortages will be the dual purpose of the Joint Production and Chemical Committee Conference of the American Gas Association which takes place Monday and Tuesday, May 24 and 25, at the Hotel Pennsylvania, New York, N. Y. Always one of the most important technical conferences of the gas industry, this year's gathering will be weighted with unprecedented problems of war origin.

E. W. Zimmerman, Eastern Gas and Fuel Associates, Everett, Mass., chairman of the Gas Production Committee, and T. L. Robey, Washington Gas Light Co., Washington, D. C., chairman of the Chemical Committee, working with able industry representatives, have arranged a program of unusual significance. In addition to A. G. A. research reports, it will include authoritative summaries of the latest developments on gas production, analyses, maintenance and repair problems.

The two-day meeting has been divided so that morning sessions will be devoted to the presentation of formal papers and reports and the afternoons will be taken up with roundtable luncheon conferences. Three luncheon meetings will be held on Monday, as follows: Water Gas—P. T. Dashiell, The Philadelphia Gas Works Co., chairman; Chemistry in the Gas Industry—Dr. F. H. Dotterweich, Texas College of Arts and Industries, chairman; and Coal Carbonization—A. C. Sedlachek, Philadelphia Coke Co., chairman.

Of timely importance is the luncheon conference on war emergency problems which will be held Tuesday afternoon. W. Cullen Morris, the gas industry's representative on the National Technological Civil Protection Committee, will preside at this meeting.

Following is the program in detail:

MONDAY, MAY 24

10:00 A.M.

Chairman's Opening Remarks. E. W. Zimmerman

Greetings. Alexander Forward, Managing Director, American Gas Association

Address. E. R. Acker, Chairman, Committee on War Activities

Two-Shell Water Gas Sets. D. S. Reynolds, Boston Consolidated Gas Co., Boston, Mass.

Approved Apparatus for Rapid Determination of Traces of Carbon Monoxide. Louis Shnidman, Rochester Gas & Electric Corp., Rochester, N. Y.

Report on Organic Sulphur Research. Dr. E. W. Guernsey, Chairman, Subcommittee on Organic Sulphur

V. J. Altieri
Vice-Chairman,
Chemical Committee

F. J. Pfluke
Vice-Chairman, Gas
Production Comm.

1:00 P.M.

Roundtable Luncheon Conferences

Luncheon No. 1

Water Gas. P. T. Dashiell, Chairman, The Philadelphia Gas Works Co., Philadelphia, Pa.

Luncheon No. 2

Chemistry in the Gas Industry. Dr. F. H. Dotterweich, Chairman, Texas College of Arts and Industries, Kingsville, Texas

Plastics and the Gas Industry. Dr. R. L. Wakeman, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Luncheon No. 3

Coal Carbonization. A. C. Sedlachek, Chairman, Philadelphia Coke Co., Philadelphia, Pa.

TUESDAY, MAY 25

9:30 A.M.

Chairman's Opening Remarks. T. L. Robey

Post-War Symposium. A. M. Beebee, Presiding, Chairman, Committee on Post-War Planning

Reports of Committee Chairmen on the Four Basic Studies:

E. W. Zimmerman
Chairman,
Gas Production
Committee

Post-War Purchasing Power and Potential Markets. C. V. Sorenson, Midland Utilities Co., Hammond, Ind.

Factors Affecting the Realization of the Potential Markets. R. J. Rutherford, Worcester Gas Light Co., Worcester, Mass. R. E. Ginna, Rochester Gas & Electric Corp., Rochester, N. Y.

Engineering and Economic Aspects of Our Own Ability To Satisfy the Potential Markets. Hall M. Henry, NEGEA Service Corp., Cambridge, Mass.

Effects of National Planning and Trends. Walter C. Beckjord, Columbia Gas & Electric Corp., New York, N. Y.

Underfiring with Refinery Gas. J. H. Long and E. E. Withem, Philadelphia Electric Co., Philadelphia, Pa.

Enriched Producer Gas Underfiring. W. O. Keeling, Koppers Co., Pittsburgh, Pa.

Reformed Gas Oil

Gas Enrichment

Carborundum Linings. A. S. Hall, Springfield Gas Light Co., Springfield, Mass.

12:30 P.M.

Luncheon Conference on War Emergency. W. Cullen Morris, presiding
including

"How the gas industry personnel is to be rated and regarded"—by a representative of the A. G. A. Committee on Personnel Practices

Maintenance and Repairs During the Emergency

Short Cut Procedures
FOR ANALYSES AND TESTS

Compiled by the Chemical Subcommittee on Analyses and Tests
Dr. Channing W. Wilson, Chairman

3-MINUTE DETERMINATION OF SULFUR IN COKE AND ASH

IT has been called to our attention by Dr. Gilbert E. Seil, of E. J. Lavino and Co., that there is available on the market equipment particularly adaptable to the determination of sulfur in coke and ash, with a large saving in time required for the determination. The entire time for making an analysis by this method, exclusive of weighing the sample, is three minutes. Detailed information about this apparatus may be obtained from the Harry W. Dietert Co., Detroit, Mich., or from the Laboratory Equipment Co., Benton Harbor, Mich. An article describing its use was also published by E. R. Vance in the August 10, 1942 issue of *Steel*.

Sulfur is determined by oxidizing the sample in a furnace in a current of oxygen. The sulfur dioxide formed is swept into an absorber containing standard sodium hydroxide solution and hydrogen peroxide, where it is converted to sulfate. The excess sodium hydroxide is then titrated directly in the absorber with standard sulfuric acid solution.

The apparatus consists of a sulfur determinator, an oxygen purifying train, and a combustion furnace. A combustion tube containing a dust trap is used at one end of the furnace. Heated to a dull red, this trap catches dust and iron oxide and converts sulfur gases to sulfur dioxide. The packing material may be easily removed and replaced when necessary.

The determinator has a chromium-plated base and supporting column for holding the glassware. A large special burette, calibrated to read sulfur percentage from 0.0 to 0.39% is carried on this supporting column. Two pipettes are likewise mounted on the supporting column. One pipette is connected to large solution bottle containing sodium hydroxide and the other is connected to hydrogen peroxide.

The center burette contains sulfuric acid solution. It is graduated to read direct in percentage sulfur.

A titration vessel equipped with agitator rinsing device and drain is mounted on the column. To facilitate titration, a daylight illuminator with milk glass plate is furnished.

Method of Test—A one-gram sample is placed in a combustion boat using 20-mesh tin as an accelerator. The products of combustion are allowed to flow through the sodium hydroxide solution in the titration vessel and are titrated with the sulfuric acid solution from the burette.

The titration vessel is drained and rinsed without being moved.

The time of the test need not exceed three minutes, exclusive of weighing the sample. The accuracy of the test is plus or minus 0.002%.

CORRECTION

IN the method for evaluating the calorific value of bituminous coals, published in this section last month, an error occurred in one of the expressions. The line reading

(Fixed carbon + A) × 100 = B

should read

(Fixed carbon divided by A) × 100 = B

Please make this correction on your copy.

Motor Vehicle Operators To Meet in New York

THE Committee on Operation of Public Utility Motor Vehicles, sponsored by the Technical Section of the American Gas Association, has arranged a one-day conference to be held May 4 at the Hotel Pennsylvania, New York. Linn Edsall, Philadelphia Electric Co., chairman of the committee, will preside at the meeting which precedes the Society of Automotive Engineers meeting scheduled for May 5 and 6.

A program committee headed by E. W. Jahn, Consolidated Gas, Electric Light and Power Co. of Baltimore, vice-chairman of the committee, has arranged a comprehensive program, including discussion of recent rationing and other restrictive orders.

Distribution Conference

THE annual Distribution Conference sponsored by the Technical Section, American Gas Association, was held April 29 and 30 in Cincinnati, Ohio, after this issue of the MONTHLY had gone to press. While a complete report of the two-day meeting will be published in June, elsewhere in this issue will be found one of the most timely conference papers, namely, "Teaching Customers How to Help Themselves as an Aid to the War Effort," by Donald S. Bittinger, Washington Gas Light Co., Washington, D. C.

Revision of Gas Chemists' Handbook
First Volume Ready in May

THE first volume of this work which is to be published in separate chapters will appear at the Production and Chemical Conference to be held at the Hotel Pennsylvania, New York City on May 24-25. It is the Gas Chemists' Book of Standards for Light Oils and Light Oil Products, by V. J. Altieri, chief chemist, Eastern Gas and Fuel Associates, Everett, Massachusetts.

The foreword by E. J. Sweeney, chairman of the revision committee, which follows in part, indicates the tremendous task the A.G.A. Technical Section committee is undertaking and the splendid cooperation received from authorities of recognized standing:

"To make a maximum contribution now to the winning of the war, members of the committee undertook to revise different chapters of the Gas Chemists' Handbook. They undertook the task of preparing an outline, circulating the outline, revising the chapter, clarifying and simplifying specifications, methods, and standards and utilizing all ideas to provide new and better tools to help win the war.

"Today there is a demand for enormous quantities of benzene, toluene, xylenes, solvent naphthas, and other light oil products. Whether these materials are used for munitions, aviation motor fuel, plastics, synthetic rubber, intermediates, or other products, the question of quality is of great importance. Nothwithstanding the strategic importance of this question, it is difficult to find an up-to-the-minute book of standards devoted solely to light oil and light oil products.

"An outline of the book had been circulated among members of the subcommittee and copies requesting ideas and comments were sent to authorities in the petroleum, chemical, coal tar and other industries. The first manuscript was reviewed by H. J. Meredith, chief chemist, Koppers Co., Seaboard Division, Kearny, New Jersey and by W. L. Glowacki, Mellon Institute, Pittsburgh, Pa. The second manuscript was reviewed by M. C. Cryan, assistant chief chemist, R. L. Jacobson, J. K. S. Swiniarski, J. Smith and M. Carron, Eastern Gas & Fuel Associates, Everett, Mass. Further collaboration and guidance was secured from other authorities.

"Written by a technologist of recognized standing, this expansion of the light oil chapter into a single book of standards

(Continued on page 232)

Soil Areas Corrosive to Metallic Iron Through Activity of Anaerobic Sulfate-Reducing Bacteria[1,2]

By R. L. STARKEY and K. M. WIGHT

R. L. Starkey

IT has been well established that anaerobic corrosion is responsible for severe damage to iron pipe lines both in the United States and in foreign lands. The importance of this type of corrosion in emphasized by recent reports which indicate that it is widespread and may result in pipe failure within ten years from the time that the pipe is buried in the ground.

Characteristics of Sulfate-reducing Bacteria

The organisms which are considered to be the principal agents of corrosion have certain well-established characteristics (3, 4, 1). They are strict anaerobes, that is, they are unable to grow in the presence of free oxygen or under highly oxidizing conditions. They utilize various organic materials as sources of energy, particularly such compounds as organic acids, lower alcohols, simple carbohydrates, and organic nitrogenous compounds. These organic materials serve as hydrogen donors for development of the bacteria.

The bacteria also require sulfate (certain compounds such as sulfite or thiosulfate can substitute for sulfate) as the specific hydrogen acceptor, and they are unable to develop in its absence. The sulfate is reduced to sulfide, and the amount of sulfide produced is proportional to the amount of organic matter decomposed. The reaction is exothermal; whereas energy is required to reduce sulfate to sulfide, a greater amount of energy is liberated through the oxidation of the organic material. Thus in no way can sulfate be considered to be a substitute for the organic matter, since both are needed and serve different purposes in the metabolism of the organism. The following is a typical reaction:

$$2\,CH_3.CHOH.COOH + H_2SO_4 \rightarrow 2CH_3.COOH + 2\,CO_2 + H_2S + 2\,H_2O\ (+\ 37\ Cal.)$$
lactic acid — acetic acid

Development of these bacteria is most active over a limited pH range. Field observations by von Wolzogen Kühr (27), Bunker (7), and Hadley (10) have shown that anaerobic corrosion is most severe close to neutrality and is seldom encountered at reactions more acid than 6.0 or 5.5. Thus anaerobic corrosion is not likely to occur under conditions favoring acid corrosion. The results of some studies with a pure culture of the bacteria developing in artificial culture media are shown in figure 1. Under these conditions the bacteria grow best between pH 6.0 and 6.5 and there was no growth at reactions more acid than pH 5.5 or more alkaline than pH 8.5. It should not be concluded that the reaction of soils and waters will have exactly the same effect on bacterial development that was observed in the artificial culture medium. The curves indicate, however, that the range of reaction over which bacterial development is most likely to be encountered is close to neutrality. All strains of the bacteria will doubtless not behave the same and various factors in natural environments may be expected to affect their development.

The sulfate-reducing bacteria are small, curved, rod-shaped, or spiral cells varying in size, but commonly measuring 1-5 x 0.5. They produce spores under certain conditions and are all morphologically alike (21). Present information indicates that the species differ only in the substances which they are able to utilize as hydrogen donors. The most commonly encountered species is named *Sporovibrio desulfuricans*. Considerable information concerning its distribution is available and this indicates that it is widespread. It occurs commonly in muds and soil (3, 4), sediments in fresh and salt water and in the waters themselves (26, 14), sea sands, sulfur springs (16), and other mineral waters (9), and sewage (19, 21), as well as in sulfur-containing rocks (24) and the waters of oil wells (2, 8). In fact, it is widely distributed in nature and it may be expected to develop whenever the conditions are favorable for its growth. Although the bacterium is most commonly active in heavy clay soils, it is not confined to these soils alone.

The mechanism of the corrosion process. The theory proposed in 1934 by von Wolzogen Kühr and van der Vlugt (27), to explain the means by which iron may undergo corrosion in the absence of oxygen, stimulated interest in this type of corrosion and provided a much-needed working hypothesis. Although critical experimental proof of the validity of all details of the mechanism is not available, the basic principle of the theory is supported by facts. According to this principle, corrosion is caused by bacterial action which results in depolarization of the system. The following equations were offered to explain the process (27):

$$8H_2O \rightleftarrows 8H^{\cdot} + 8(OH)' \quad \left.\begin{matrix}\\ \end{matrix}\right\} \text{Anodic solution of iron} \quad \text{(a)}$$
$$4Fe + 8H^{\cdot} \rightleftarrows 4Fe^{\cdot\cdot} + 8H \quad \left.\begin{matrix}\\ \end{matrix}\right\} \quad \text{(b)}$$
$$CaSO_4 + 8H \rightarrow H_2S + 2H_2O + CA(OH)_2 \quad \text{Depolarization} \quad \text{(c)}$$
$$Fe^{\cdot\cdot} + H_2S \rightleftarrows FeS + 2H^{\cdot} \quad \left.\begin{matrix}\\ \end{matrix}\right\} \text{Corrosion products} \quad \text{(d)}$$
$$3Fe^{\cdot\cdot} + 6\,(OH)' \rightarrow 3Fe(OH)_2 \quad \left.\begin{matrix}\\ \end{matrix}\right\} \quad \text{(e)}$$
$$4Fe + CaSO_4 + 4H_2O \rightarrow FeS + 3\,Fe(OH)_2 + Ca(OH)_2 \quad \text{Summary} \quad \text{(f)}$$

Depolarization is effected by the bacteria through removal of the hydrogen which is present on the cathodic areas. This can be accomplished by certain bacteria which are able to reduce sulfate under anaerobic conditions; the sulfate becomes the hydrogen acceptor and is reduced to sulfide. The sulfide in turn reacts with some of the anodic ferrous iron and produces ferrous sulfide; a still larger amount of iron becomes ferrous hydrate. Some other bacterial transformations are theoretically able to serve as depolarizers but their practical significance in corrosion has not been established (28, 20).

There is such an amount of evidence that sulfate-reducing bacteria can cause anaerobic corrosion of iron that there is scarcely reason to doubt their relationship to the process. The following is some of the supporting evidence. The products of corrosion contain a high percentage of sulfur and the area of soil about the metal surface is black with iron sulfide (27, 28, 25, 7, 11, 12). Sulfate-reducing bacteria can be recovered from the corrosion products in greater abundance than at a distance from the metal surface (7). Corrosion of iron has been experimentally produced by sulfate-reducing bacteria whereas no such corrosion occurred under similar conditions in the absence of the bacteria (7). Various soil conditions which favor development of sulfate-reducing bacteria are sites of particularly active corrosion. The metallic iron surface becomes depolarized during development of the bacteria (13).

All details concerning the parts played by organic matter and cathodic hydrogen in development of the bacteria which are responsible for anaerobic corrosion are not yet established. There is no doubt that organic matter is readily utilized by the bacteria for

[1] Journal series paper, New Jersey Agricultural Experiment Station, Rutgers University, Department of Soil Microbiology.

[2] The material contained in this report was prepared in connection with a project sponsored by the American Gas Association. This project is under the direction of the Subcommittee on Pipe Coatings and Corrosion of the Technical Section Distribution Committe.

growth. In fact it provides the energy for their development under the most commonly used cultural conditions in the laboratory. Furthermore, field evidence indicates that corrosion is particularly severe under conditions where organic matter decomposes close to the metal surface. Hadley (12) has provided remarkable evidence of this in his illustration of a streak of corrosion of a steel pipe directly beneath a piece of rope which had by chance been buried upon the pipe.

Utilize Cathodic Hydrogen

It has been demonstrated that the bacteria can activate molecular hydrogen and there is now definite evidence that they utilize cathodic hydrogen. The results of Stephenson and Stickland (23) are particularly significant in this connection. These investigators used a suspension of the bacterial cells under conditions unfavorable to growth but favorable to action of the enzymes of the bacteria. Under these conditions, they observed that the bacteria used molecular hydrogen to reduce sulfate to sulfide in the proportions indicated by the following equation:

$$H_2SO_4 + 4\ H_2 \rightarrow H_2S + 4\ H_2O$$

The evidence concerning the utilization of cathodic hydrogen to bring about the same reaction has been little more than suggestive until very recently. Pont (18) reported that the bacteria reduced sulfate to sulfide in a medium to which no organic matter was added but which contained steel wool. No experimental details were given and certain experiments by Hadley (13) and the authors performed with the idea of testing the same principle gave negative results. Berkalof and Cobasso (5) reported experiments which were believed to indicate that under anaerobic conditions metallic iron surfaces were depolarized by the bacteria and the cathodic hydrogen was used for bacterial development. The first definite evidence of depolarization was recently reported by Hadley (13) who made measurements of potential changes accompanying development of the bacteria under carefully controlled conditions.

On the basis of the available information, the conditions favoring bacterial development about surfaces of metallic iron can be explained as follows:

Growth of the bacteria is dependent upon a supply of organic matter. The organic compounds which the bacteria require are obtained in part directly from plant residues and in part from decomposition products of other bacteria. The principal substances of this latter type are organic acids produced during anaerobic decomposition of cellulose and other plant carbohydrates. Sulfide which is produced by reduction of sulfate through growth of the sulfate-reducing bacteria upon these organic substances may react with the iron surface to produce ferrous sulfide. Once the bacterial cells are present in abundance they are able to utilize hydrogen for sulfate reduction. This hydrogen may originate from the reaction between sulfide and the metallic iron, or it may be cathodic hydrogen, or even hydrogen which is produced by other bacteria through anaerobic decomposition of carbohydrates. Thus, the removal of cathodic hydrogen and consequently depolarization of the iron system is dependent upon organic matter to produce the bacterial cells. When the cells are present they are able to utilize the hydrogen through their hydrogen-activating enzyme systems. Corrosion might therefore result through the combined action of hydrogen sulfide and depolarization brought about through removal of cathodic hydrogen by the mechanism proposed by von Wolzogen Kühr.

Present information concerning the metabolic characteristics of the sulfate-reducing bacteria, as well as observations which have been reported concerning factors associated with corrosion in the field, support this explanation. In fact, according to this explanation it would be predicted that the rate of corrosion would increase with time and this is indicated by Hadley's results (11, 12).

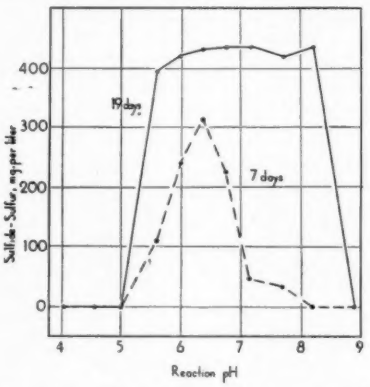


Figure 1—Influence of reaction upon growth of sulfate-reducing bacteria in a culture medium

Since the cathodic protection of pipe lines has been used with success in controlling anaerobic corrosion, it might be of interest to consider the influence of such treatment on the activities of the sulfate-reducing bacteria. According to the explanation of corrosion presented above, cathodic protection would not prevent development of the bacteria upon the available organic compounds in the soil. Sulfide would be formed in proportion to bacterial growth and additional sulfide might be produced through use of some of the hydrogen coming from the iron surface. The extent of the use of the hydrogen would be determined principally by the ability of the bacteria to develop at the metal surface. In case cathodic protection creates surface conditions unfavorable for bacterial development, the amount of hydrogen used would be greatly reduced and might be negligible. Corrosion would be confined to the simple reaction between this sulfide and the iron, and even this reaction might be impeded by some protecting influence of the hydrogen film. Corrosion through depolarization according to the mechanism of von Wolzogen Kühr would be entirely blocked and therefore loss of metallic iron would be greatly reduced.

Many suppositions have been introduced in developing this explanation. This is inevitable in any attempt to arrive at an understanding of the relationship of the bacteria to the corrosion process on the basis of the information which is available at the present time. Additional facts are needed, however, to establish the basis for a sound concept.

Soil conditions favorable to anaerobic iron corrosion

The experiments which are reported in the following pages were undertaken with the view of developing field methods to differentiate non-corrosive soil conditions from those which are corrosive through the action of sulfate-reducing bacteria. Sufficient is known of the growth requirements of these bacteria to make some generalizations about the soil conditions under which they are active. The organisms are anaerobic; they require organic matter for growth and sulfate as the hydrogen acceptor; and they develop over a rather definite range of reaction (pH). These characteristics suggest certain observations and measurements that may give some indication as to whether or not a soil is favorable for their development and consequently likely to become corrosive through their development.

The topography of the land and the appearance of the soil samples obtained from the region where the pipe is located can frequently serve to indicate whether or not conditions are anaerobic.

The abundance of readily decomposable organic matter in the soil might give some indication of soil corrosiveness provided the soil is waterlogged. As yet, however, no suitable field method for determining material such as this has been noted.

Even though sulfate is required by the bacteria, conditions can be imagined under which most of the sulfate had been converted to sulfide so that very little remained even though corrosion was severe. Thus, sulfate content would not be expected to show any regular correlation with severity of corrosion.

It should be possible to recover sulfate-reducing bacteria from corrosive locations. In view of the fact that the bacteria can also be obtained from soils where there is no anaerobic corrosion, tests for their presence are of doubtful value. Quantitative methods for determining their abundance are still inaccurate.

Since it is known that the bacteria are sensitive to acid conditions, information regarding the soil reaction (pH) is particularly important in detecting corrosive areas. Soils more acid than pH 5.5 would seldom be expected to be responsible for anaerobic corrosion whereas the most corrosive soils have been found to have reactions close to neutrality.

Anaerobic corrosion occurs under condi-

tions where free oxygen is excluded and sulfide is produced and persists. One would therefore expect that a soil which is strongly corrosive would be very much reduced. Under the influence of free oxygen in well aerated soils, plant residues and labile reduced compounds become rapidly oxidized by microorganisms whereas there is an accumulation of reduced substances under anaerobic conditions. Differences between such soils can be distinguished through measurement of their oxidation-reduction potentials (29, 6, 17). Consequently, it should be possible to establish some correlation between the corrosiveness of a soil and its reduction intensity. Since comparatively little information is available as to the potential levels of aerobic and anaerobic soils or to the influence of sulfate reduction on soil potentials, experiments have been carried out to obtain information on these points.

Numerous different elements may comprise the redox system of any soil, but there is no agreement in published reports as to the factors which exert the dominant effects (29, 6, 17, 15). One of the important and possibly the most important redox system in soils is $Fe^{++} \rightleftarrows Fe^{+++}$. There are also other inorganic as well as organic components of the soil redox system.

TABLE 1

REDOX POTENTIALS OF AEROBIC AND ANAEROBIC SOILS TREATED WITH SOME ORGANIC MATERIALS*

Organic matter added	*Addition of sulfate*	*Reaction, pH*	*E_h, mv.†*	*Presence of sulfide*
		Aerobic		
Untreated	—	6.7	520	
Untreated	+	5.8	465	
Grass roots	—	6.3	491	
Grass roots	+	6.0	561	
Corn stover	—	6.3	559	
Corn stover	+	5.9	454	
Alfalfa	—	6.1	532	
Alfalfa	+	5.7	488	
		Anaerobic		
Untreated	—	7.0	93	+
Untreated	+	7.8	105	+++
Grass roots	—	7.0	88	+
Grass roots	+	7.4	69	+++
Corn stover	—	6.7	116	+
Corn stover	+	7.3	76	+++
Alfalfa	—	6.9	113	+
Alfalfa	+	7.8	104	+++

*Incubation period, 5 months.
†Corrected to pH 7.0.

Potentials produced by cultures of S. desulfuricans in solution medium

Before making determinations on soils, preliminary tests were made with cultures of the sulfate-reducing bacterium growing in a relatively simple culture medium containing sodium lactate as the only organic constituent and various inorganic nutrient salts. Measurements were made on the medium for several days before inoculation to insure that the system had come to equilibrium. Typical results are shown in Figure 2. The sterile medium had a stable potential close to 300 mv., but after being inoculated the potential dropped rapidly to a level of —150 to —250 mv. There was comparatively slight additional change in potential upon prolonged incubation as long as the system remained tightly sealed. The potential drop was due to products resulting from growth of the bacteria. One of the principal products of growth was sulfide; at the end of the incubation period the concentration of sulfide-sulfur was about 400 mg. per liter. The same type of experiment has been repeated several times with essentially the same results.

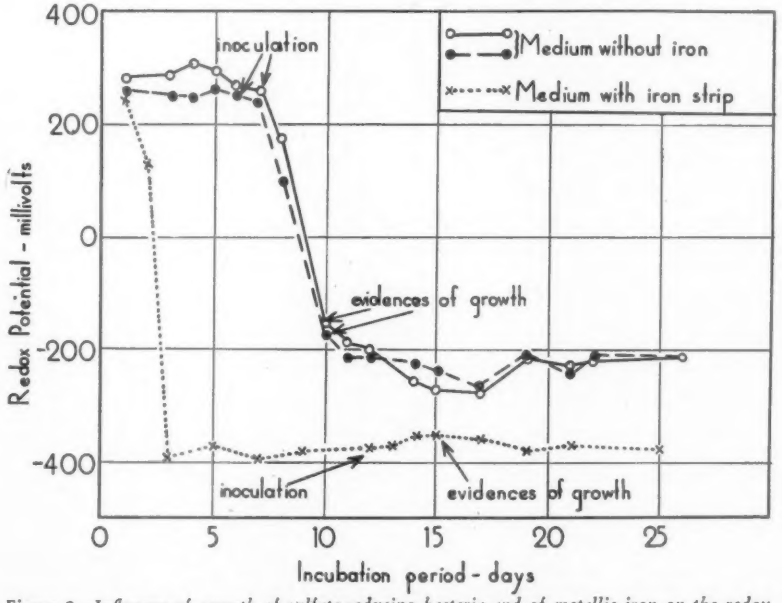


Figure 2—Influence of growth of sulfate-reducing bacteria and of metallic iron on the redox potentials of a culture medium

Similar tests were made with sterile solutions to which varying amounts of sulfide were added with the following results:

Sulfide-sulfur, mg. per liter	*pH*	*E_h, mv.**
0	7.0	+276
59	7.5	—134
166	7.6	—138
435	7.6	—143
706	7.6	—148
1078	7.6	—158

*Corrected to pH 7.0.

It can be concluded that the sulfide which is produced by the bacteria by reduction of sulfate is responsible either directly or indirectly for the drop in potential.

Iron has an important influence on the potential of soil and on the surfaces of corroding metal. Both ferric and ferrous iron occur in soil materials and the relative amounts of the two will be determined by the reducing or oxidizing conditions and the pH (22). Ferrous iron uncontaminated by appreciable amounts of ferric iron will produce very low potentials under anaerobic conditions. This is shown in Figure 2. In fact the potential dropped from 250 mv. to about —400 mv. This final potential is considerably below that produced by

S. desulfuricans in a similar medium in the absence of metallic iron and persisted without appreciable change even though the medium was inoculated and the culture grew well and produced an abundance of sulfide. Similar reactions were also noted where other forms of iron were used.

Potentials of aerobic and waterlogged soils

These results, obtained with such a comparatively simple system as the culture medium, give little except qualitative indications as to what will happen in soils. Not only is the soil medium heterogeneous but the activities of numerous different kinds of microorganisms complicate interpretation of the results.

Numerous experiments have been made to obtain some idea of the potentials of aerobic and anaerobic soils. One of these experiments will suffice to indicate the results. Fertile soil received additions of certain organic materials in amounts equal to one per cent of the weight of the soil. In some cases a small amount of magnesium sulfate was added to provide sufficient sulfate for maximum requirements of the sulfate-reducing bacteria. One series of soils was kept moist but aerobic; another series was saturated with water and kept in closed containers which prevented penetration of oxygen and thus created anaerobic conditions. Strips of metallic iron were kept buried in these soils in order to determine the effects of the various treatments on corrosion. The results reported in Table 1 were obtained five months after the experiment was started.

The soil reactions were all close to neutrality but the aerobic soils were slightly more acid than the anaerobic ones. In no case was there evidence of sulfate reduction in the aerobic series whereas the waterlogged soils showed blackened areas, more in the sulfate-treated soils than in those to which no sulfate had been added. The potentials of the aerobic soils were all much alike irrespective of the addition of organic matter. There is no doubt that microbial activities had been greatly increased in those soils by the addition of organic matter. Nevertheless no differences were noted between the potentials of the soil to which organic matter had been added and the untreated ones. The potentials of the aerobic soils were between 450 and 560 mv. whereas the potentials of the waterlogged soils were consistently much lower, averaging about 100 mv. Thus the spread between aerobic and anaerobic soils was about 400 mv. and it is easy to distinguish between the soils from the potential measurements.

It has been reported above that the potentials produced by the sulfate-reducing organism in the culture medium were between —150 and —250 mv. and those produced by metallic iron were still lower. The soil potentials produced by the normal mixed population of soil microbes, including the sulfate-reducing bacteria, were higher than this. Negative potentials have been obtained with soils in other experiments, but these cases are rare. Numerous other factors than ferric and ferrous irons may have influenced the soil potentials. Nevertheless, since no appreciable differences were noted between the differently treated anaerobic soils and since some of them had received additions of considerable organic matter it seems likely that the organic materials produced during decomposition did not directly affect the soil potentials to an appreciable extent. There is more likelihood that there is something common to all of the soils such as the iron system which had the dominant role in determining the potentials. The reduced organic substances produced during decomposition may be presumed to have had an indirect effect on the soil potentials by reduction of ferric to ferrous ions.

In the foregoing experiment fertile top soil which contained considerable organic matter was used. This is believed to be the reason why the potentials dropped to low levels after waterlogging even though no fresh organic matter was added. The organic matter already present in the soil may be presumed to have been sufficient to support an active microbial population. This explanation is supported by other experiments in which a subsoil was used which was very deficient in organic matter (Table 2). With the subsoil, the potential dropped only slightly due to waterlogging, but in other portions of the same soil to which organic matter was added the potentials fell to low levels. In this experiment the soils were submerged under water in beakers left open to the air. Consequently the potentials are somewhat erratic. The results indicate, nevertheless, the importance of decomposition of organic materials in creating anaerobic conditions and otherwise favoring corrosion.

Relatively few field soils of known corrosiveness have been tested yet, but the results which have been obtained seem to indicate that soils in which there is severe corrosion are characterized by low potentials. These potentials are, moreover, of the same order as those of the laboratory-treated soils. Data on some field soils is presented in Table 3. The soil which appeared to be definitely aerobic from field observations had a high potential (soil 12), those which were classified as anaerobic had very low potentials, and the ones which were designated as intermediate were variable. On the basis of reaction (pH) alone, soils 1-6, 12, and 13 are the only ones which would have been classed as corrosive, with soil 8 as a borderline case. It would be presumed that all of the other soils would have been too acid to support active development of *S. desulfuricans*.

On most soils the potential measurements were made in the field and again in the laboratory several days after the samples were taken. The two sets of determinations are in essential agreement except that lower potentials were generally obtained on the samples taken to the laboratory.

For purposes of discussion let it be assumed that potentials lower than 200 mv. indicate strongly reducing conditions favorable to corrosion, potentials from 200 to 400 mv. are intermediate and indicative of moderately reducing conditions unlikely to be more than mildly corrosive, and poten-

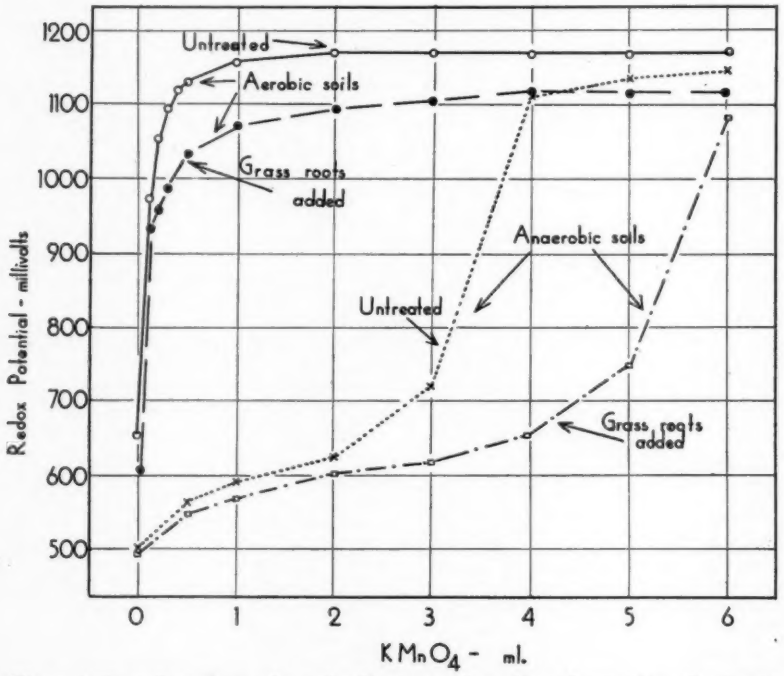


Figure 3—Potentiometric titrations of acid extracts of aerobic and anaerobic soils. Experimental laboratory soils

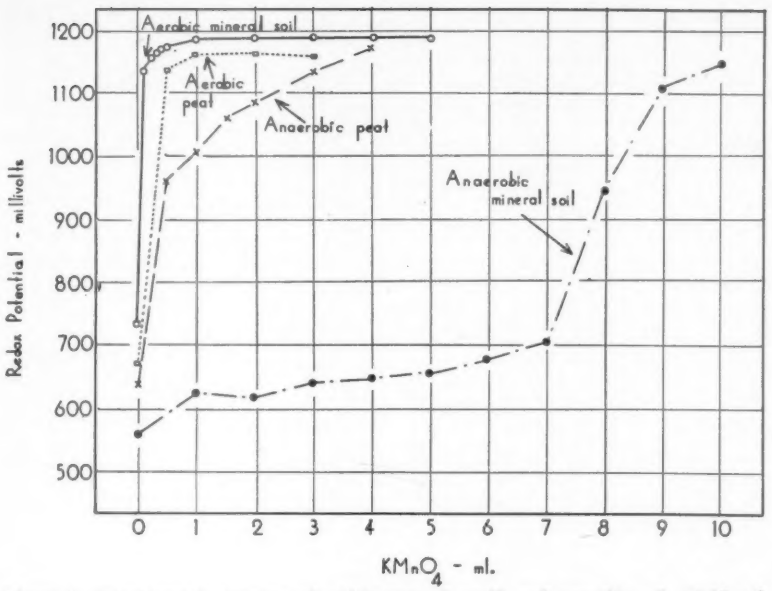


Figure 4—Potentiometric titrations of acid extracts of aerobic and anaerobic soils. Field soils

tials higher than 400 mv. are too highly oxidative to favor anaerobic corrosion. Obviously the data which has thus far been gathered is too fragmentary to justify these assumptions except as a tentative basis for discussion. According to this scale soils 1-6, 8, 11, and 13 would be classified as strongly reducing, soils 7 and 9 as intermediate, and soil 12 as aerobic. The classification of soil 10 is somewhat uncertain since the potential measurement made in the field differed considerably from that made some days later on a sample of the same soil in the laboratory. On the basis of both reaction and potentials, soils 1-6 and 13 seem to be particularly favorable for anaerobic corrosion. The other anaerobic and intermediate soils would not be classified as corrosive since the reactions are somewhat too acid to favor active development of the sulfate-reducing bacteria.

There may be some additional factors, however, which are not revealed by the data. It has been observed by Bradfield, Batjer, Oskamp and Peech (6, 17) that the redox potentials of subsoils vary considerably during different seasons of the year. They observed that the potentials were lowest during the spring and highest in late summer and they ascribed the differences to changes in the water table which influenced the depth of penetration of oxygen from the air. The activities of microorganisms would likewise be affected by this change. The data on soils 1-12 were gathered during the last of August when it may be assumed that conditions were somewhat more favorable for soil aeration than at other periods of the year. Not only is it likely that the potentials of some of these soils were lower during the spring months but the soil reactions were no doubt also higher. Under aerobic conditions various materials including sulfide become oxidized to more acidic compounds whereas these reactions are reversed when oxygen is excluded. In this connection it is of interest that sulfur-oxidizing bacteria were found in all of the anaerobic and intermediate soils that were tested but they were not detected in the aerobic soil, number 12. Thus, in the soils where conditions were favorable for formation of sulfide through reduction of sulfate, organisms were present which could oxidize the reduced sulfur compounds to sulfate whenever the soil environment became aerobic.

The reactions of soils 7-11 were all close to the limiting pH for *S. desulfuricans* and comparatively small changes in reaction would have created conditions favorable for its development. Therefore the fact that there was evidence of corrosion in soils 8 and 11 is not difficult to explain. In fact, the likelihood exists that soils 7 and 9 would have been moderately corrosive at certain periods of the year. Additional studies will indicate the extent to which this interpretation is justified. Not only is information needed on more soils but the influence of seasons on soil potentials and reactions should likewise be examined.

Potentiometric titrations of aerobic and waterlogged soils

The potential measurements reflect the intensity factor of the redox potential. That is, they indicate whether or not the potential is high or low, but fail to give any information as to the amount of reducing material in the soil. This latter capacity factor was determined by potentiometric titrations of soil extracts with an oxidizing agent. A 1:1 suspension of the soil in 0.1N H_2SO_4 was prepared. After standing for 48 hrs. with occasional stirring, aliquots of the extract were titrated with the oxidizing agent, 0.01N $KMnO_4$. Some typical results are shown in Figures 3 and 4. The treatments which the laboratory soils received previous to incubation resulted in marked differences in subsequent titrations for reducing substances. When samples were tested five months after the experiment was started, very small amounts of permanganate were required to oxidize the labile constituents of the untreated aerobic soils, and only slightly more was needed for the sample to which 1 per cent organic matter had been added (Figure 3). The soils changed greatly, however, under the influence of anaerobic conditions. From 10 to 50 times as much permanganate was required to raise the potentials of the anaerobic soils to the stable level as the similarly treated aerobic soils. Differences are also apparent between the anaerobic soils themselves; as might be expected, the soil to which decomposable organic matter had been added, required more of the oxidizing agent than the one which received no addition of organic matter.

The peats did not react the same as the

TABLE 2

REDOX POTENTIALS OF A SUBSOIL TREATED WITH SOME ORGANIC MATERIALS AND KEPT UNDER AEROBIC AND ANAEROBIC CONDITIONS

Organic matter added	*Reaction, pH at various incubation periods, days*						*E_h, mv* at various incubation periods, days*					
	12	*31*	*64*	*75*	*86*	*91*	*12*	*31*	*64*	*75*	*86*	*91*
					Aerobic							
Glucose	6.2	6.5	5.9	6.7	6.1	6.2	645	594	590	607	599	549
Cellulose	6.4	5.9	6.3	6.7	6.4	6.5	614	537	668	712	544	593
Grass roots	6.8	5.7	6.2	6.5	6.5	6.1	671	568	635	632	655	500
Alfalfa	6.5	5.6	6.4	6.0	6.4	6.5	581	551	633	493	693	604
Peptone	7.3	5.4	6.7	6.7	6.3	6.5	658	523	551	536	664	501
					Anaerobic							
Untreated	6.4	6.4	6.5	6.9	6.6	6.3	460	515	463	637	524	434
Glucose	6.4	6.0	5.3	4.9	5.1	4.6	350	348	167	152	238	137
Cellulose	6.1	6.4	6.4	7.0	6.6	6.3	530	338	250	289	197	195
Grass roots	6.0	6.0	6.3	6.7	6.5	6.2	436	321	159	186	213	159
Alfalfa	6.2	6.0	6.6	6.7	6.6	6.4	191	420	368	303	160	352
Peptone	6.5	6.6	7.0	7.1	7.1	6.7	173	345	112	147	111	109

*Corrected to pH 7.0.

mineral soils. As shown by Figure 4 very little permanganate was required to oxidize the reduced substances in the acid extract of the aerobic peat. In this respect it was much the same as the aerobic mineral soil. The anaerobic peat contained somewhat more reduced material, but only a small fraction of the amount which was found in the anaerobic mineral soil. This can be explained in part by the fact that the same weight of wet peat as wet mineral soil was used in preparing the acid extracts. The peats had much higher moisture contents than the mineral soils and they were therefore much more dilute suspensions. On the basis of equivalent dry weights of soil material the peats would have had considerably greater titrations than those shown in the figure. It may prove to be desirable to make some allowance for the moisture contents of the soils in calculating the titrations. Without some change in the procedure it can be concluded that at least with certain peats, potentiometric titrations are poorer criteria of reducing conditions than direct measurements of redox potentials. With mineral soils, both measurements reveal marked differences between aerobic and anaerobic soils and somewhat greater proportional differences are shown by the titrations. The titration procedure is limited in its practical application by the fact that it requires more time and equipment than the direct measurement of redox potentials.

Concluding Remarks

Corrosion of iron under anaerobic conditions through the agency of sulfate-reducing bacteria is both widespread and destructive. Means are available for providing satisfactory protection against this type of corrosion but the methods which have been used for locating corrosive areas are inadequate. Inspection of the pipe is the only direct and truly effective means of detecting corrosion but it is impossible to expose all buried pipe for periodic inspection. If it was possible to determine with some degree of certainty from soil tests whether or not a location would be likely to prove corrosive, protection could be provided at the time the pipe was laid and inspection of pipe lines could be limited to the corrosive areas.

The results discussed in this report indicate that highly reducing soil conditions can be detected from redox potential measurements. Furthermore, laboratory studies have shown that development of sulfate-reducing bacteria is associated with strongly reducing conditions. Still more significant is the fact that field soils show similar correlations between soil corrosiveness and the degree of reduction of the soil materials. There is, therefore, reason to believe that information regarding the land drainage and topography and the texture of the soil, together with knowledge of the soil reaction (pH) and reducing conditions (E_h) can be effectively used to distinguish corrosive from non-corrosive locations. Additional studies with field soils are needed, however, to establish the practical value of redox potential measurements as criteria of corrosion.

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Restaurant Trade Up

FOOD sales in restaurants are running at an average of 34% ahead of last year, according to American Restaurant Association. Increases have been greatest in restaurants doing more than $25,000 a year gross business than it has been in restaurants doing less than that amount.

TABLE 3

CORRELATIONS BETWEEN CORROSIVENESS, REDOX POTENTIALS, AND OTHER SOIL CHARACTERISTICS

Soil No.	*Location of site*	*Soil Characteristics*	*Depth, feet*	*Moisture content, per cent*	*Classification of corrosivity*	*Presence of sulfide*	*Loss on ignition, per cent*	*pH*	E_h, mv*	
									Field	*Laboratory*
1	Deerfield, Ohio	Clay alluvium; water table near surface (6")	0.5	26.0	Severe	++	4.4	6.5	101	38
2	Deerfield, Ohio	Clay alluvium; water table near surface (6")	1.0		Severe			6.7	115	73
3	Deerfield, Ohio	Clay alluvium; water table near surface (6")	1.5		Severe			6.9	127	11
4	Deerfield, Ohio	Clay alluvium; water table near surface (6")	2.0		Severe			6.6	107	24
5	Deerfield, Ohio	Clay alluvium; water table near surface (6")	2.5		Severe			6.5	145	47
6	Deerfield, Ohio	Sediment in stream bottom	—	37.1	Severe	++	6.1	6.7	123	—272
7	Mogadore Swamp Portage County, Ohio	Peat, swamp area	Surface	76.2	—	—	66.5	5.4	329	280
8	Mogadore Swamp Portage County, Ohio	Peat, swamp area	2 to 3	75.5	Moderate	—	65.4	5.6	180	167
9	Bedell farm, Mahoning County, Ohio	Clay, water table at pipe depth	Close to pipe	22.0	Moderate	±	4.0	5.3	358	227
10	Randolph, Ohio	Peat	Surface	58.2	—	—	54.5	4.9	360	499
11	Randolph, Ohio	Peat	2	61.5	Rather severe	—	36.6	5.3	178	69
12	Austintown, Ohio	Loam, well drained	2 to 3	9.7	Mild	—	4.8	6.0	—	541
13	Newark, N. J.	Peat	18	83.4	Severe	±	66.7	7.0	—	192

*Corrected to pH 7.0.

Laboratories

GEORGE E. WHITWELL, *Chairman*
R. M. CONNER, *Director*
F. A. ALLEN, *Supervisor, Pacific Coast Branch*

Laboratories Add Women Scientists to Research Staff

ONE of the most difficult problems in the operation of the American Gas Association Laboratories, resulting from wartime conditions, is that of maintaining adequate scientific personnel. Until quite recently the practice had been followed of employing young graduate engineers to fill practically all openings which occurred. A relatively large turnover was normally experienced due principally to the recognized function of the Laboratories in providing the gas industry with a supply of men trained in gas utilization to take positions with utility companies and manufacturers. No difficulty was encountered in securing qualified men for replacements as they were required.

Conditions are now radically changed. Within about two years, 27 former staff members entered the armed forces and are now scattered all over the world. Numerous others have taken new positions within and without the industry. While testing operations have been much curtailed, as a result of suspension of manufacture of gas appliances by many factories preliminary to their conversion to war production, research activities on the other hand have increased. Furthermore, the Laboratories have themselves engaged in direct war work to such an extent that it now constitutes their major activity. These developments have greatly intensified the manpower problem.

Manpower Scarce

Repeated contacts with engineering and scientific schools which were formerly readily able to supply qualified graduates have all ceased to produce the desired results. War demands for trained scientists have made it impossible to secure men as before. Therefore the obvious course appeared to be to employ women possessing the necessary scientific education and assign them to such research projects for which their experience and training qualified them. A precedent existed in that in certain previous instances women with home economics training had been employed temporarily to assist in special investigations, such as comparative cooking tests using gas and electricity and establishment of test procedures for evaluating quality of baked foods. In all these cases it was found that women were able to make very valuable contributions and their accomplishments were such as to afford good practical reasons for utilizing their abilities more fully as regular staff members.

In selecting women for research, a scientific degree from a recognized college

Gertrude Kable who has the distinction of being the first woman on the A. G. A. Laboratories' staff

was agreed upon as a prerequisite. Any specialized training, such as in home service work or similar lines, was also felt to be highly desirable. Names of possible candidates were obtained by correspondence with college placement bureaus, home service directors and others. Utility company sales departments and home service directors were particularly helpful in making contacts with women possessing these qualifications. So far, three have been employed and are now actively engaged in various current research projects.

The first woman added to the staff was Gertrude Kable. She had previously been in the employ of the Central Illinois Light Company at Peoria, Illinois, as a home service representative. In addition to her routine activities, she participated in home service demonstrations and lecture courses and conducted nutrition classes for the American Red Cross. Miss Kable holds a B.S. degree in Home Economics from Iowa State College, Ames, Iowa, where she majored in household equipment. One of the courses which this school offers to such students has for several years included inspection visits to a number of industrial establishments, among them our Laboratories. It also includes practical test methods specified by various gas appliance approval standards, thus providing ideal preliminary training for domestic gas utilization research.

Mrs. Paul Lawrence, who next joined the staff, was graduated from Ohio State University with a major in home economics. For several years she was employed by the Industrial Rayon Corporation of Cleveland, Ohio, where she secured extensive training in its physical and chemical laboratories work. Mrs. Lawrence's present association with our organization is especially interesting in that her husband was a member of our engineering and testing staff for some 2 years before accepting the position of development engineer with the Richmond Radiator Company of Uniontown, Pa. After about 4 years in the manufacturing side of the industry he entered military service and was recently commissioned in the Anti-Aircraft Division of the Coast Artillery.

Gertrude Henry is the third and most recent addition to our research department. She received a B.S. degree from New York State College of Home Economics at Cornell University. Later she attended an appliance course offered by the General Electric Corporation at Nela Park. For some 3 years, Miss Henry was a home service representative with the Central Hudson Gas and Electric Corporation, Poughkeepsie, New York. Before coming to the Laboratories she was extension specialist in household equipment on the staff of the College of Home Economics, Cornell University. In this capacity she instructed adult classes in conserving household equipment, including gas appliances. She thus possesses a combination of both theoretical and practical training which should prove most valuable in her present work.

Accomplishments of these three young women in research to date have fully demonstrated their ability to engage successfully in such activities. It seems only logical that women should possess to a greater extent than men certain essential qualifications necessary for best carrying out investigational work on equipment which is largely purchased and used by women. It is confidently expected that a number of additional women will be employed shortly along similar lines. Many applications have been received and a keen interest exhibited in the Laboratories' research program. Everything considered, it is believed that a most constructive step has been taken which should prove of great benefit not only in meeting our present manpower shortage but in permitting our industry's research program to proceed without interruption.

NATURAL GAS SUPPLY UNDER WAR CONDITIONS

(Continued from page 182)

need for installing compressors, looping existing pipe lines or laying entirely new main gathering lines. The amount of steel required in individual cases is measured somewhat by the volume of new gas required to be replaced on the maximum system day and the location of the new supplies with respect to transmission mains—a part of this construction requirement can be met from time to time by lifting and relaying lines and moving idle compressor equipment but in many instances the only practical solution lies in the use of new materials. There is growing evidence of this type of need in some localities—it is not something to postpone until the day of actual necessity—it is not a post-war problem—it is a must that calls for planning and execution in advance of the day of actual shortage of gas.

I do not believe it is an overstatement to say that these production needs of the industry are of sufficient importance to justify their full recognition. They are inherent with our type business and to meet the need would only be giving fair consideration to the values and economies which can be derived from the maximum use of natural gas in the war program. It is the industry's responsibility to show the way and press for those considerations to which it is justly entitled. It is the responsibility of the War Production Board and Petroleum Administration for War to see that the natural gas industry receives a fair proportion of such total supply of critical materials as can be made available for use by essential industry.

This discussion so far has dealt largely with matters that relate only to the continuance of our business of producing and transporting gas to points of consumption on the basis of present market demands. This is not the full story of the critical materials situation presently confronting the natural gas industry. During recent years many new markets have been attached and war conditions have brought about many new manufacturing processes and new industrial plants—all of these combine to create added demands for our service. In instances, the resulting conditions call for increased transmission capacity in the form of additions to plant, which becomes an involved problem in these days of shortages, high taxes, increased expenses, reduced operating and construction personnel, and lowered earnings in many individual cases.

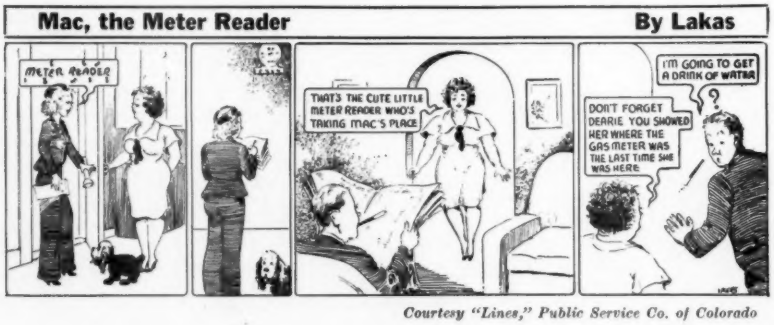
There is no escaping the fact that war conditions bring about strange situations. Situations that depart so radically from normal processes that—to paraphrase—seem, in instances, to make bedfellows of businesses that heretofore have been active competitors. I refer particularly to the transportation of natural gas and its relationship to the whole transportation problem. If one form of transportation breaks down, the deficiencies of that one must be made up by another, and the other being already overloaded, the whole thing breaks down. As a result the public suffers inconvenience and the war effort is retarded. My point is, that under existing conditions, all forms of transportation are interrelated and interdependent, therefore it becomes the duty of the men in our industry not only to look to the gas supply phase of the business, but to see that the facilities used to carry natural gas from the well to the consumer are carefully maintained and fully and effectively operated. Anything less would simply mean that we are not doing our part.

Sales Restrictions

Turning for the moment to the retail branch of the industry, certain restrictions on the sale of natural gas were placed in effect in many parts of the country more than a year ago. From time to time these prohibitions against sales have been extended to other areas until now there are but few gas utility companies and market areas that are not affected. Then, too, the manufacture and sale of gas appliances have felt the heavy hand of the oppressor—war. None will deny that these war measures, of forced curtailment of the normal growth of gas utility sales, have resulted in substantial contributions of both critical materials and a vital fuel, to the war effort and few question the wisdom of this action. Even a superficial check of the present activities of gas appliance manufacturers will show that many of their plants are busily engaged in war work and their contribution is a material one whether in the form of specialized equipment for war plant industrial processes or the manufacture of munitions.

Conservation Advertising

Proof of the fact that utilities look upon natural gas as vital to the war program is clearly shown by their cooperative effort in the program of advertising which has been carried on in recent months. In this campaign of discouraging wasteful use of gas, the public has been told much about the peak load problem, the underground storage of gas, the tremendous use of gas in essential war work and other educational facts. In supporting this Government-sponsored fuel conservation program, the natural gas industry with the assistance of the American Gas Association Publicity and Advertising Committee, has established a record in which it may take justifiable pride. In the case of several companies, no gas shortage existed, nor was there imminent danger that one would exist, yet these companies, along with others somewhat less fortunately situated, did



Courtesy "Lines," Public Service Co. of Colorado

their patriotic part in emphasizing the need for gas conservation.

Out of all of the chaos and waste and destruction that accompany war, if we but look beyond the present confusion and uncertainty we shall be able to glean some satisfaction in the fact that the very forces that would destroy us, compel advancement if we become strong enough to defeat the enemy. This compelling influence has already resulted in marked progress in new developments, through scientific skill, and the resulting advancement far outstrips that which we would otherwise witness over a long period of years.

With the coming of peace, this creative effort, of the war period, will bring forth new horizons and afford new opportunities. While it will take vision and courage to measure up to the opportunities and responsibilities of the future, we know that the natural gas industry has such attributes of character within its ranks. Nothing less would have established this industry that today is an outstanding example of accomplishment under a system of free enterprise. To these men the things to come after the war, offer new fields in which to spread the benefits of a superlative fuel and further opportunity for the history of this industry to repeat itself.

Largest Reserves in History

Broadening this appraisal of the present state of the natural gas industry, I might add these observations:

Known natural gas reserves on a country-wide basis, estimated to exceed ninety trillion cubic feet, are probably the largest in the history of the industry. Therefore, the supply problem reduces itself to the matter of maintaining deliverability and making known reserves available to those areas where the rate of discovery has not kept up with that of withdrawal. This in short is the crux of the whole supply situation.

The retail branch of our business, except as it is influenced by the expansion of service to war industries, continues to function under enforced conditions of "status quo," which from all outward appearances will continue for the duration. As a result, merchandising has been materially reduced and most construction activity suspended.

The whole industry has suffered a serious loss of manpower through enlistments and the effect of the Selective Service Act. One recent survey showed that such losses varied from a minimum of seven or eight per cent to a maximum of thirty-five per cent. The ratio of this loss by groups, to the total number of employed persons being influenced by the average age of the group. Then, too, the labor situation has been further aggravated by the loss of workers who are attracted to other industries because of higher rates of pay. The whole situation will undoubtedly grow more acute and while there are many things we can and should do to keep intact the necessary operating personnel of this essential industry, there is no escaping the fact that as time passes we shall become more and more conscious of the importance of women workers and oldsters in the natural gas industry.

Try as I may to look upon the dark side of things, I always find some favorable factors in our business outlook. Right now we are enjoying a larger volume of sales than ever before in our history and while taxes and other forms of expense cut heavily into income, it is my conviction that the industry remains in a strong position. True, many companies have been hurt earnings-wise, yet in contrast, a few have registered gains.

On the whole, an analysis would show that the affairs of the natural gas industry are in a sound state—it has suffered fewer dislocations than many other types of business. Its record is clean—there has been no hint of scandal in the conduct of its affairs—its business is intact. Furthermore the industry's service has been of such nature as to warrant the belief that we have strengthened the ties between company and customer and in contrast with the general upward trend in the cost of practically all commodities, the cost to the consumer of natural gas, with few exceptions, has not risen and in several areas substantial price reductions have been made. This war period record is impressive and one that we may be proud of. To me, it exemplifies the spirit of this industry.

FUTURE OF NATURAL GAS AND ITS DERIVATIVES

(Continued from page 205)

100, which will permit engines probably not dreamed of even five years ago, are now more than within the realm of probability through this newly discovered reaction. It is to this chemical reaction of paraffin alkylation, a tool which has many unexplored applications in the field of chemistry, that the United Nations owe their present superiority over the Axis nations in aviation fuels.

One of the most recent commercial processes—isomerization of normal butane to convert it to isobutane—has made available for isooctane alkylation a new supply of needed raw materials.

The volumes of selected fuels and selected fuel ingredients currently being produced is, of course, a military secret. We know that the volumes are large and that new facilities are constantly being created to make still larger volumes. No one can risk a guess as to what these fuels will make possible in the way of new pleasure cars and commerial aircraft for the simple reason that the same technological revolution is going on in other industries. Along with new light metal alloys and new plastic materials of construction, the effect of fuel quality will be only one of the items which will cause us to scrap our pre-war models of cars and aircraft.

Chemical developments in the natural gas industry other than fuels are numerous. Many of the products are used to a large extent as starting materials for the preparation of still other chemical products. Synthetic rubber and rubber ingredients are probably the ones which are of most universal interest at this time. Synthetic rubber also constitutes one of the larger potential outlets for gas raw materials. The rapid growth of the synthetic rubber activity, is of course, traceable to the needs of war. Basically, the synthetic rubber industry is being built around the Buna-type rubbers, using a synthetic latex prepared from styrene and butadiene. A number of other types of synthetic rubber, namely, Neoprene, Thiokol

and Butyl rubber are likewise being manufactured but in lesser quantity.

Natural gas is also an important raw material in processes for the manufacture of high explosives. It is being cracked to produce hydrogen which is reacted with atmospheric nitrogen to produce ammonia. The ammonia is readily oxidized to nitric acid, which combines with toluene to form T.N.T. The reaction of ammonia with nitric acid yields ammonium nitrate, a base for explosives which is also a valuable fertilizer in peace-time.

Glycerine for the production of trinitroglycerine is another explosive raw material being made from natural gas.

Basic Materials for Plastics

Natural gas hydrocarbons after conversion to the corresponding olefins can be used as the basic materials for a wide range of plastics. Innumerable plastics are required for the manufacture of war implements. Likewise, they are being used in non-defense applications as substitutes for strategic metals, rubber and silk vitally needed in armaments. Most conspicuous of their war applications is in the housing enclosing the combat stations of bombardier compartments in aircraft. Plastic washing machine agitators, refrigerator door panels, sealing frames and freezing compartment doors are some of the many domestic uses of plastics.

A great amount of research is going forward in the field of natural gas as a chemical raw material. Undoubtedly, we can look forward to many more discoveries which will be of help in the present emergency and which will also fit into the scheme of things in the post war world.

We have shown you many of the things which we in the natural gas industry have to look forward to, both as to fuel uses, and as to the use of the extracted fractions, as raw materials in the chemical synthesis of many varied and useful products. The road in the past has not been easy, and the future will not reveal itself advantageously unless we continue with our best efforts. The competition will be keen. Our greatest competitors as well as other organizations are planning their post war economy.

Capacities of large power and fuel companies which have been increased during this emergency will make available a surplus of electric energy and a surplus of other energy which may be used for cooking, water heating, space heating, house heating, and industrial purposes. The competing fuel, which has most nearly solved the industrialist's operating problems during this war emergency is most apt to get the greater share of stored up good-will in the return to peace-time economy. In this regard, we believe the natural gas industry has made rapid strides, but we must continue our efforts.

In conclusion, we believe that natural gas and its derivatives have a great and bountiful future. The reserves are plentiful for years to come. The many new developments of derivatives are permitting the natural gas producers to obtain a market for the heavier fractions without appreciable effect on the amount of gas available for sale as a fuel. There are many new and improved uses of natural gas as a fuel already in the making; undoubtedly, more will be developed. The natural gas industry should move forward with confidence.

Appreciative Employees

IT was the consensus of the group that an amazingly small percentage of employees are leaving gas companies for higher paying jobs despite the opportunities at the present time for higher paying war jobs."—Minutes recent meeting A. G. A. Committee on Personnel Practices.

REVISION OF GAS CHEMISTS' HANDBOOK

(Continued from page 222)

covers the subject thoroughly. Much new material appears for the first time. It includes a complete account of recent developments in practical fractional distillation analyses. It presents the fundamentals concerning specifications, definitions, tests and other standards.

"This book can and will play an important role, both in the war economy and the post-war economy. It will help conserve and up-grade materials. It will aid efforts made to simplify work. It will be useful in the E.S.M.W.T. Program which already has taught many skills to more than 500,000 men. It will help to expedite the formulation of new standards needed to meet new situations and it will help to speed up the procurement of men and materials for war.

"One task covered by this book of standards was the extremely difficult one of attempting to correlate the different requirements of different producers, consumers, government agencies, technical associations, educational institutions, production control and employee training programs."

The Committee on Revision of Gas Chemists' Handbook is made up of the following:

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Dr. C. W. Wilson, Consolidated Gas Elec. Light & Power Co. of Baltimore, Baltimore, Md.

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Executive with a successful background of sales and general management experience with both large and small companies. Tireless worker, aggressive and thinks straight. College graduate, middle forties, now living in middle West. Will locate anywhere. Christian. References. **1459.**

Industrial Engineer—More than 15 years' experience in plant surveys and sales force advisory engineer for more efficient use of fuel and power. Desire represent manufacturer as agent, financially responsible—could handle liaison work in connection with war contracts or act as sub-contract manager and consultant. N. Y. P. E. (4H). **1460.**

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